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Intermountain Power Agency. A cultural Resource Inventory of the Kaiser Steel Corporation South Lease Mine Property and a Test Excavation (42EM1343 in Emery County, East Central Utah conducted by Rebecca Rauch (1981). These and additional survey reports of the area are included in Appendix 4-1.

Detailed archeological ground surveys were conducted at the Lila Canyon mine site and associated disturbed area, by Montgomery Archaeological personnel. ~~This~~These surveys ~~was~~were conducted in 1998, 1999, and ~~1999~~2006 and is included within Appendix 4-1.

Within the Horse and Lila Canyon Permit areas and the nearby Southern portion of the Kaiser Steel Corporation South Lease mine property, there are five known historic resources that are either on or eligible for listing on the National register. There is one listed site (42EM1222) 2.5 miles from the facility area. One eligible site (42EM1343) has been recovered and another (42EM2517) will be recovered prior to construction. The other two eligible sites (42EM2255 and 42EM2256) are not expected to be impacted by operations.

411.141. Historic resources are depicted on Plate 4-3.

411.141.1 The locations of listed or eligible cultural and historical resources in the area are discussed in Appendix 4-1 and shown on Plate 4-3.

There are no publicly owned parks.

411.141.2 No cemeteries are located in or.within 100 feet of the proposed permit area.

411.141.3. No land within the proposed permit area is within the boundaries of any units of the National System of Trails or the Wild and Scenic Rivers System.

411.142. Consultation efforts for cultural and historical resources are in process. Final concurrence from the SHPO will be included in this MRP prior to permit approval.

UEI will also include measures to prevent or minimize adverse impacts to listed sites within the permit area, if sites are discovered during the consultation process.

411.143. The Operator has provided archeology survey reports. ~~Two~~Three of these surveys included intensive survey and analysis of areas that would be directly impacted by the Lila Canyon mining operations.

Two other surveys include spot surveys and analysis of areas that are expected to have a low probability of indirect mining impacts to the surface.

411.144 Of the ~~nineteen~~22 cultural and historical sites identified in the area, only one, 42EM1222, is listed on the National Register of Historic Places. This site is approximately 2.5 miles from the Lila Canyon surface facility and therefore, impacts are not expected to occur at this site.

BLM will develop a recovery plan for 42EM2517 that will occur after mine plan approval and before construction.

411.200. Previous mining and exploration activities have occurred within the proposed permit area within the last twenty years. In the mid-1950's, the road along the bottom of Lila Canyon was constructed to allow exploration of the resources. The road intersects the Horse Canyon Highway approximately 1.4 miles to the north and loops back to the south to intersect Highway 191 and 6 to the south (see Plate 4-1). Two sealed breakouts (Plate II-2 of Horse Canyon Plan) are located in the left fork of Lila Canyon where the Lila Canyon fan was installed in the 1950's. The Lila Canyon fan was used until the closure of Horse Canyon post 1977, and therefore, the current Coal Regulatory Program has jurisdiction over this disturbance and it is included in the permit area.

411.210. Coal was removed from the outcrop of Horse Canyon and transported back through the Horse Canyon Mine. Excavation indicates only a small amount of coal was previously removed.

411.220. In the past, coal was removed from the Sunnyside Seam.

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Summary of Notable Results As of 200~~5~~6

The inventory of the various studies and reports within the Horse Canyon and Lila Canyon Extension areas located many cultural resource sites. The following sites lie within the bounds of the Horse Canyon and Lila Canyon Extension area and are historic sites. These sites are depicted on Plate 4-3.

42Em1121 The site is a small lithic scatter consisting primarily of debitage of red, grey and white chert material. In addition, a metate described as a flat slab with a pecked central depression was also noted on the site area. The site is located in a pinyon-juniper grove interspersed with small clearings of sagebrush. The site does not meet National Register Criteria for age, unique architecture, historic persons or events.

42Em1222 This site is a blazed tree, dated 1878 and inscribed “Sam Gilson by God”. Sam Gilson owned a ranch in Juab County. In June of 1878, while driving a herd of horses to the railroad in Wyoming, Gilson camped in Horse Canyon and carved the inscription in a pynion juniper. Gilson is also known for discovering asphaltum, also known as Gilsonite. The site also contains the signature of W.B. Liddell (July 11, 1906) and James Brace (August 17, 1912) on a rock outcrop on the southwest corner of the site area. This site is eligible to be placed on the National Register of Historic Places. It is on private land and falls within the Lila Canyon Mine permit area. It is approximately 2.5 miles north of the proposed disturbed surface area.

42Em1223 This site consists of a non-significant wooden root cellar, dug into an embankment. The site does not meet National Register Criteria for age, unique architecture, historic persons or events.

42Em2099 This site is the Geneva Mine Works which is the largest, newest, and most technologically advanced of all the sites. The mine works were built in 1942 metates were noted, one consisted of a flat slab with a central pecked area, the other was a trough metate. A test excavation was performed at this site. The site does not meet National Register Criteria for age, unique architecture, historic persons or events.

42Em1344 This is a prehistoric site comprised of small lithic scatter approximately 20 meters in diameter. The lithic material consists of 25 bifacial thinning flakes of white chalcedony. Five bifacial thinning flakes appear to have been utilized. The site does not meet National Register Criteria for age, unique architecture, historic persons or events.

42Em1375 This is a prehistoric site of lithic scatter consisting of 50 flakes of white chalcedony within a 5 meter diameter area. The site appears to be a single activity site and the lithic material is consistent throughout the site area. Artifacts consisted primarily of secondary and tertiary bifacial thinning flakes. The site does not meet National Register Criteria for age, unique architecture, historic persons or events.

42 Em2255 (Miller) This is a prehistoric site of lithic scatter. The site is buired (buried), it was defined by the extent of ant hills containing small lithic flakes. Very few flakes were found on the surface between ant hills. Cultural material did not show up in the walls of little park wash, east of the site. If the flakes are an indication of undisturbed buired (buried) cultural material the site could yield important information. This site does meet National Register Criteria for age, unique architecture, historic persons or events. This site will be managed under the stipulations of the Programmatic Agreement.

An extensive search by MOAC archaeologists and a revisit by Blaine Miller (personal communications, September 2006) both failed to relocate the site.

If mining operations change to include surface facilities near the site then participating agencies of the Programmatic Agreement will reconvene.

42 Em2256 (Miller) This is a prehistoric site of lithic scatter. The lithic flakes are widely scattered around the area. Most of the observed flakes wee in ant hills, indicating some buired (buried) deposits. A fence of piled junipers has been constructed on the ridge some time in the past. Diagnostic artifacts are not available to date this part of the site. The surface attributes of the site will not contribute important information. However, buiried (buried) material may be present that would yield important information. This site does meet National Register Criteria for age, unique architecture, historic persons or events. This site will be managed under the stipulations of the Programmatic Agreement.

If mining operations change to include surface facilities near the site then participating agencies of the Programmatic Agreement will reconvene.

42Em2517 This is a small Fremont component rock shelter situated on the primary terrace of an intermittent drainage at the mouth of Lila Canyon. The shelter has been extensively potted. An eroded spoil pile occurs in front of the shelter. The looters pile contains charcoal and oxidized sandstone rocks as well as most of the artifacts described. The site does meet National Register Criteria for age, unique architecture, historic persons or events. A data recovery plan has been prepared by Montgomery Archaeological Consultants. The data recovery plan will be implemented once the Notice to Proceed is given by the BLM which will occur after Permit approval. The BLM will be the overseeing agency. The implementation dates, and project locations will not be determined until the BLM notice to proceed is given, after permit approval. The overseeing agency for the EA mitigation will be the BLM. Details will be reported to DOGM in the Annual Report immediately following the notice to proceed. This site will fall under the commitments of the Memorandum of

Agreement ("MOA").

42Em3622 This is a historic corral located at the base of a slope of a ridge near an ephemeral stream. The corral measures approximately 44 ft by 72 ft in size and is roughly an oval shape. The average length of each section of fence for the corral is 15 ft 6 in. The corral is of straight-rail construction and consists of two upright posts wired together at the top and bottom with six horizontal posts in between. All of the posts appear to have been axe-cut. The eastern length of the corral has been impacted by a small landslide that has pushed the fencing over and several other sections of the corral have begun to deteriorate. Several large old trees and a large boulder are located within the corral. No other features or artifacts were documented at the site. The corral occurs in a land patent issued in 1942 to Louis Arthur Warren. This site does not meet National Register Criteria for age, unique architecture, historic persons or events.

42Em3623 This is a historic trash scatter located along a small drainage on a slight slope of a ridge with an escarpment to the immediate south. The site measures 42 by 19 meters and is situated in a pinyon and juniper woodland. The material culture located at the site consists of one glass bottle and 36 tin cans. The clear glass liquor bottle has an Owens-Illinois Glass Co. Trademark and is embossed "federal law forbids sale or reuse of this..." above 'quart one quart one quart one ..." along the shoulder and is embossed with a wheat band along the base of the bottle 9dating between 1934 and 1964). The tin cans located at the site were documented as either within a tin can concentration or scattered across the site. The consist of one hole-in-top milk can, one Hills Bros coffee can, two lard buckets, a rectangular Westler Brand Olive Oil can, and three sanitary food cans. The tin cans located in the concentration consist of nine hole-in-top milk cans embossed Punch Here" (dating between 1935 and 1945), three hole-in-top milk cans (dating between 1917 and 1930), twelve sanitary food cans of various size, two Hills Bros coffee cans, and one sanitary external friction lid. No features were documented at the site. This site does not meet National Register Criteria for age, unique architecture, historic persons or events.

42Em3659 This is a historic temporary camp located just inside the pinyon/juniper treeline at the base of a low ridge. An alluvial plain covered by low sage is located just north and east of the site. The artifacts located on the site consist of four glass bottles and a jar, 12 crushed can lids, one .22 caliber rim fire cartridge casing, one worn out black rubber boot heel, pieces of metal wire, pieces of rubber hose, and 109 tin cans. The tin cans were mostly within a tin can concentration at the norther end of the site, while the rest were scattered across the site. The 109 tin cans consist of 50 hole-in-top milk cans, eight of which were embossed with "punch Here" (1935-1945), two Hole-in-cap cans (1908-1914), and 57 sanitary cans that include pocket tobacco tins, meat and other food cans, cooking oil, lard buckets, and coffee cans. There is one pint liquor bottle that has an Owens-Illinois Glass Co. makers mark (1929-1954) and is embossed with "federal law forbids sale or reuse of this bottle" (1933-1964). The bottle has a metal screw cap and is broken into two pieces in the middle. There is one clear beet bottle from the Leisy Brewery Company in Peoria Illinois (1884-1920). There is one clear jar with a metal screw top lid and a Ball Brothers makers mark (Post 1919), possibly preserves/jam. There is one clear soda bottle with no makers mark that is broken into 30+pieces. There are two features at the site. Feature-A is a hearth/FCR concentration with flecks of charcoal in the center. It consists of about 30 brown sandstone rocks with fire-reddening/oxidation. The pieces of fire cracked rock vary in size from 15x7" to 3x2". Feature-B is a fire wood pile measuring 4'2" east-west by 5' 10" north-south. It consists of 60-70 pieces of axe cut wood. The pieces of wood are from juniper branches and trunks and average one foot in length. This site does not meet National Register Criteria for age, unique architecture, historic persons or events.

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524.748 The type and length of the stemming will be recorded on the blasting record.

524.749 Mats or other protections used will be recorded on the blasting record.

524.750 Since all structures are either owned by the permittee and not leased to another person or are located over six miles distance from the permit area a record of seismographic and airblast information is not required.

524.760 Since a blasting schedule is not required this section does not apply.

524.800 The operator will comply with the various appropriate State and Federal laws and regulations in the use of explosives.

525. Subsidence: The permittee will comply with the appropriate R645-301-525 requirements.

525.100 Subsidence Control Plan

525.110 Plate 5-3 shows the location of State appropriated water and 5-3 (Confidential) shows the eagle nests that potentially could be diminished or interrupted by subsidence.

525.120 SUBSIDENCE POTENTIAL (See also Section 5.4 of Part "A")

A review of renewable resources in and adjacent to the permit area found resources consisting of ground water, grazing, timber, and ~~water supply~~recharge areas. Subsidence from underground coal mines has been believed to affect overlying forest and grazing resource lands in the following ways:

- ~~•~~o Formation of surface fissures which intercept near surface soil moisture thus draining the water away from the root zone with deleterious effects.

- ~~•~~o Alterations in ground slope and destabilization of critical slopes and cliffs.

- o Modification of surface hydrology due to the general downward migration of surface water through vertical fractures.

- o Modification of groundwater hydrology including connection of previously separated aquifers ~~and~~, reduction in flows of seeps and springs which rely upon tight aquitards for their flow, and changes in recharge mechanisms.

- o Emissions of methane originating from the coal seam through open fissures to the surface or at least the base of the surficial soil which has been known to have deleterious effects on woody plants.

Because these renewable resources exist with and adjacent to the permit area, a subsidence control plan is required. This plan is presented in Section 525.400.

A great deal of baseline data is available from many mining settings to develop subsidence damage criteria for surface structures (Bhattacharya et al. 1984). The formation of cracks and fissures are the general effects of subsidence and can have minor deleterious effects on groundwater resources without any fissuring to the surface. In the arid areas of Utah, impacts to and modification of the groundwater regime can be disruption of flow from natural seeps and springs which rely on the permeability contrast of interbedded sandstones and shale for their flows. These water resources are generally near surface occurrences and are essentially surface waters and subject to the same limiting damage criteria as surface water bodies. Subsidence damage to surface water bodies has been studied by a number of workers including Dunrud (1976), Wardell and Partners (1976), and U.S. Bureau of Mines (1977). The results of the Wardell and Partners studies of subsidence effects in a number of countries indicates that the limiting strain for the onset of minor impacts to surface waters is approximately 5×10^{-3}. The SME Mining Engineering Handbook also suggests a limiting extension strain value of 5×10^{-3} for pasture, woodland, range or wildlife food and cover.

Table 10.6.19 in the Mining Engineers Handbook suggests that the minimum safe cover required for total extraction of the coal resources under surface waters is approximately 60 times the seam thickness for coal beds at least 6 feet thick or approximately 450 feet. In their review of the foregoing, Singh and Bhattacharya (1984) recommended that the same limiting safe strain values and cover thickness ratios be used for protecting groundwater resources and recharge areas over coal mines. Where extension strain is greater than this limiting value, it is likely that surface fissures and cracks may develop. As the strain value decreases below the limiting value, the potential for surface damage decreases.

Figure 1 in Appendix 7-3 shows a typical subsidence profile. As shown in Figure 1, the zones are: a caved zone that occurs in the 6 to 10 times the thickness of the coal seam, a fractured zone which occurs 10 to 30 times the thickness of the coal seam, and deformation zone which occurs 30 to 60 times the thickness of the coal seam, and finally, a soil zone which occurs on the ground surface. The cover thickness of 1,000 to over 2,000 feet, over most of the mine area is also much greater than the limiting thickness of 630 feet recommended by International Engineers Inc. (1979) (10.5' x 60).

The Lila Canyon mine will be a longwall operation. As projected, 15 longwall panels at various depths will be mined. The longwall panels are laid out with the gate roads running along the strike roughly north-south, which will result in the longwall shear cutting up and down the dip. The depth of cover over the longwall panels approaches but never gets less than 500 feet toward the southwest and increases to over 2500 feet in the northeast. Only three of the 13 planned longwall panels are under less than 1,000 feet of cover. The remaining 10 panels are under 1,000 plus feet of cover. Maximum subsidence is expected to be approximately 9.5 feet in the areas approaching 500 feet of cover and less than 3' in the deeper cover areas. Extension strain varies from 12.4 $x10^{-3}$ in the 500 foot cover areas to .9 x 10^{-3} in the 2,500 foot cover areas. Extension strain values of 5.0 x 10^{-3} and above occurs in areas of approximately 1000' of cover and less.

A typical longwall panel at the Lila Canyon Mine will have dimensions of approximately 950 feet wide and up to 7,000 feet long and 2,000 feet deep. Using the methods described in the National Coal Board's *Subsidence Engineers' Handbook,* the

Maximum Subsidence
& Expected Extensive
Strain (NCB 1975)

	Feet	Meters
Panel Width =	900	274
Seam Height =	10.5	3

Depth of Cover		Width to Depth (a)	Maximum Subsidence(S)		Factor NCB Fig. 15	Extension Strain (E)
Feet	Meters	Ratio	Feet	Meters	Factor	x 10^{-3}
500	152	0.9	9.5	2.9	.65	12.4
1000	305	0.75	7.9	2.4	.66	5.2
1100	335	0.71	7.5	2.3	.68	4.6
1200	366	0.68	7.1	2.2	.70	4.1
1300	396	0.65	6.8	2.1	.70	3.7
1400	427	0.59	6.2	1.9	.75	3.3
1500	457	0.54	5.7	1.7	.78	3.0
2000	610	0.38	4.0	1.2	.82	1.6
2500	762	0.28	2.9	0.9	.80	0.9

The most favored technique until recently has been the use of the empirical ~~harts~~charts developed by the National Coal Board (NCB). The above calculations were obtained using the empirical charts developed by the National Coal Board (NCB). Comparisons, as stated in the SME handbook, of US subsidence data with NCB predictions highlight the following differences between coalfields in the US and UK: Most of the studies in the US are limited to the Eastern US coalfields with a very limited data base applicable to western conditions.

With the exception of Illinois, maximum subsidence factors observed in US coalfields are less than predicted by NCB.

The limit (draw angles in the US coalfields tend to be less then the 35 degree value generally accepted by NCB.

The points of inflection of the subsidence profiles over US coal mines are generally closer to the panel centerline compared to the NCB profile. This effect is dependent not only on the percentage of competent strata in the overburden but also on their locations relative to the ground surface and their thickness.

ranges from 0' to approximately 2,300'. The rocks overlaying the coal seam are sandstones and mudstones with some thin bands of coal. Due to the strength of the overburden and depth of workings, even with full seam extraction, only minimal subsidence if any is anticipated.

525.440 Aerial subsidence monitoring will be done annually while the significant subsidence is taking place. The subsidence monitoring will be initiated in an area prior to any 2nd mining being done within that area. Initially a 200 foot grid along with baseline photograph will be established prior to any 2nd mining. Approximately 12-16 control points will be needed to cover the total mining area. Six of these points will be located outside of the subsidence zone. The accuracy of this survey will be plus or minus 6" horizontally and vertically. From this data a map will be created that will show subsided areas. Once per year a follow up aerial will be performed to determine the extent and degree of active subsidence. Subsidence monitoring will continue for a minimum of 5 years after the mining ceases. If at the end of the 5 year period the annual subsidence in any of the 3 prior years measures more than 10 percent of the highest annual subsidence amount, subsidence monitoring will continue until there are 3 consecutive years where the annual subsidence amount is less than 10 percent of the highest annual subsidence amount. If for three years in a row the subsidence is measured to be less than 10% of the highest subsidence year, subsidence will be determined to be complete, and no additional monitoring for that area will be required.

A ground survey of the general mine permit area will be performed in conjunction with the quarterly water monitoring program. During the ~~normal water monitoring program~~ground surveys any cracks observed will be noted and reported to DOGM.

Two areas of the permit have stream reaches with less than 1,000 feet of cover over the coal seam. As discussed in Section 525.120, it is not envisioned that subsidence will negatively impact these areas.

~~However, during and following mining near these areas, special attention will be paid to these areas during the~~During periods of 2nd mining under areas of intermittent or perennial streams, a ground survey will be conducted of the stream channels every two weeks. These ground surveys will be continued for a period of 3 months following the 2nd mining.

The ground survey will consist of walking and photographing the various areas of the surface over the mine where subsidence might occur. If evidence of subsidence is identified, the area of subsidence will be surveyed and the extent of the disruption identified. Depending on the extent and location of the damage, mitigation measures will be reviewed and implemented. Due to the fact that mitigation options change with time as new technology and measures are developed, better options may be implemented in the future. However, UEI provides a commitment that where subsidence damage affects uses of the surface, the land will be restored to a condition capable of maintaining the value and reasonable foreseeable uses which it was capable of supporting before the subsidence. The surface effects will be repairs as described in Section 525.500.

525.450 Subsidence control measures.

525.451. No backstowing or backfilling of voids used as a subsidence control measure is planned at this time. Therefore, this section is not applicable.

525.452. Support pillars as a subsidence control measure is not anticipated at this time. However, an area of partial mining where an unmined coal block will be left for subsidence control is shown on Plate 5-5. First mining indicates an area where a block of coal is roomed leaving pillars for support with no mining of the remaining pillars. Partial mining as shown on Plate 5-5 indicates an area where a block of coal has been isolated without the rooms being developed. Both first mining and partial mining will leave support that can be used to control subsidence. If the details.

526.116 The only coal mining and reclamation operations that are planed within 100 feet of the County Road are office complex, sediment pond, topsoil pile, and security shack. The permit area adjacent to the county road will be fenced to protect the public from the sediment pond and other mine associated buildings. Other than fencing no additional measures are planned after the construction phase. During construction measures to control traffic on the County Road will be taken to protect the public from construction related hazzards.

526.116.1. A cooperative agreement with Emery County as stated in Appendix 1-4 requires a six foot chain link fence to be constructed adjacent to the Lila Canyon Road to provide safety to the general public in the proximity to the mine site and mine related structures and activities.

526.116.2. At the current time there are no plans to relocate any public road.

526.200 Utility Installation and Support Facilities.

526.210 All coal mining and reclamation operations will be conducted in a manner which minimizes damage, destruction, or disruption of services provided by oil, gas, and water wells, oil, gas, and coal-slurry pipelines, railroads, electric and telephone lines, and water and sewage lines which may pass over, under, or through the permit area, unless otherwise approved by the owner of those facilities and the Division. Since no existing services are found within the projected disturbed area, no negative impact to any service is anticipated.

~~A BLM and State Lands Utility Right-of-Way has been applied for to contain an access road, rail from the~~

~~existing main line near highway 10, electric power, phone lines, and gas service. This ROW is not included within the MRP and will not fall under the R645 regulations.~~

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526.220 The new support facilities are described in section 520 and in Appendix 5-4 and shown on plate 5-2 and will be operated in accordance with the mine reclamation plan. Plans and drawings for each support facility to be constructed, used or maintained within the permit area are found in Appendix 5-4, Plates 5-7A, 5-7B, and 5-8.

526.221 The new facilities designs shown in Appendix 5-4 prevents or controls erosion and siltation, water pollution, and damage to public or private property, and:

526.222 The new facilities designs shown in Appendix 5-4 minimizes damage to fish, wildlife, and related environmental values; and minimizes additional contributions of suspended solids to stream flow or runoff outside the permit area to the extent possible by using the best technology currently available.

Islands of undisturbed areas within the permit area will be visually monitored for coal fines deposition. If monitoring reveals coal fine deposition, then water sprays on the area from which the fines are originating will be warranted as per August 27, 1999 Approval Order.

526.300 Water pollution control facilities consist of sedimentation control and properly designed sewage systems.

The sedimentation control is accomplished by containing all disturbed area runoff in a properly sized sedimentation pond. Complete designs are presented in Appendix 7-4 and on Plate 7-6.

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722. Cross Sections and Maps

722.100 Subsurface Water. The locations where subsurface water, including springs and seeps, have been identified are presented on Plates 6-1 and 7-1 and data results are included in Appendix 7-1. Relevant cross sections of subsurface water, geology, and drill holes are shown on Plate 6-1. Where sufficient data are available, the seasonal head differences are presented on contour maps (see Figure 7-2A) and on a piezometer hydrograph plot (see Figure 7-2B).

722.200 Surface Water. Location of all streams and stockwatering ponds or tanks in the area of the mine are shown on Plate 7-1. There are no perennial streams, lakes or ponds known to exist within the proposed permit or adjacent areas.

A new diversion work ~~has recently~~was thought to have been constructed by the BLM in 2004 at the confluence of the Right Fork of Lila Canyon and Grassy Wash. Water from this diversion ~~is~~was directed to the stock pond located in Section 28, T. 16 S., R 14 E. Figure 1 in Appendix 7-9 shows the location of the diversion and the alignment of the diversion channel to the stock pond. Also, the location of the overflow channel back to Grassy Wash is also presented on the figure. However, the BLM was not involved in the pond improvements. Recent site investigation 2006 shows that the diversion structure described in Appendix 7-9 has been breached and no flow now reaches the pond from Grassy Wash. No other ditches or drains are known to have been constructed in the area of the mine.

722.300 Baseline Data Locations. Locations of all baseline data monitoring points are shown on Plate 7-1. Baseline water quality and quantity data is included in Appendix 7-1.

722.400 Water Wells. Three wells and three piezometers have been identified in the permit and adjacent areas. Two wells are located within the alluvium of lower Horse Canyon Creek. Three water piezometers were drilled in the area, IPA #1, IPA #2 and IPA #3, to monitor mine water levels. Drill hole S-32 was drilled and converted to a water monitoring hole by Kaiser in 1981. The details of these wells and piezometers are discussed in Section 724.100 of the application. The location of all these wells and piezometers is shown on Plate 7-1. No information on any other wells has been identified.

6-1. These water quality data are representative of the completion zone of the well (Upper Sunnyside Coal Seam and zone beneath the coal). The location of S-32 is shown on Plate 7-1. The Permittee visited S-32 in 2002 and attempted to measure water levels, but found that piezometer S-32 was unusable.

Spring and Seep Data. JBR Consultants Group (1986) conducted a spring and seep inventory of the Horse Canyon area during the fall of 1985. During the study, no springs or seeps were located within the disturbed area or near the proposed surface facilities. Within and adjacent to the permit area, 19 springs and seeps were found. Flows occurred from either sandstone beds located over shales or from alluvium. The flow rates from the springs varied from less than 1 gpm to about 10 gpm. Table 7-1 shows the flow rates and field data for each site. Sample results are listed in Appendix 7-6.

Based on the data, nine of the springs occurred from alluvial deposits in the stream channels or in colluvium. Nine of the remaining springs discharge from sandstone located above less permeable shale. Spring (H-92) was developed by excavating into bedrock. The discharge from this spring is through a pipe.

An additional spring and seep survey was conducted in the area, including the proposed Lila Canyon Mine area, by Earthfax Engineering in 1993 through 1995. Results of this survey are included in Appendix 7-1 of this permit. This is the most consistent and most recent data; therefore, this data has been used for baseline monitoring in Appendix 7-1.

All of the spring and seep sites identified from the various surveys are presented on Plate 7-1A. The geologic source for the springs can be determined by comparing Plates 6-1 and 7-1 and 7-1A. Additionally, the elevation of the sampling points can be estimated from the topographic base map. All groundwater use (seeps and springs) within the permit and adjacent areas is confined to wildlife and stock watering.

It should be noted that a number of sample sites and monitoring holes have been noted in previous submittals. Sites A-26 and A-31 were mentioned in the Horse Canyon Mine Plan; however, these sites were drilled in 1981, and no data is available as to location and/or water quality data. These sites are considered non-usable for this plan. Sites H-21A, H-21B, H-18A, H-18B, HC-1A and an unidentified spring 1000' southwest of HCSW-2 have been mentioned; however, no sample data or pertinent information is available for these sites, and they have been removed from Plates 7-1 and 7-1A. Plates encountered, the water, which is not needed for underground operations, will be collected, treated as necessary, and pumped to the surface for discharge under the terms of the UPDES permit.

Groundwater Systems. In the Lila Canyon Lease area, the groundwater regime consists of two separate and distinct multilayered zones. The upper zone consists of the Wasatch Group which includes of the Colton Formation, the undifferentiated Flagstaff Limestone-North Horn Formation, and the Price River Formation. These formations contain groundwater in isolate, perched aquifers. These perched zones are classified as aquifers because they supply groundwater in sufficient quantities for a specific use (as specified by R645-100-200). The lower zone consists of the Blackhawk Formation (where the coal seams are located). This formation consist of low-permeable strata which contain groundwater in isolated saturated zones. Based on the definition in the State coal mine regulations (R645-100-200), there is no aquifer in the lower saturated zone, because the water is not developed for a specific use nor does the strata transmit sufficient water to supply water sources. Additionally, there is no discharge from this zone along any fault or fracture or in any adjacent canyons. The two zones are separated by the Castlegate Sandstone. This zone is a porous, fairly clean sandstone. According to Fisher, et.al. (1960), the Castlegate Sandstone does not have any shales, clays, siltstones, or mudstones. The lower zone is underlain by the Mancos Shale, a very impermeable marine shale.

Geologic conditions in the permit and adjacent areas are described in detail in Chapter 6 of this P.A.P. Though discussed in several publications for the general Book Cliffs area, formal aquifer names have not been applied to any groundwater system in the permit and adjacent areas because the geometry, continuity, boundary conditions, and flow paths of the groundwater systems in the area differ somewhat from the general published discussions. However, the data do suggest that groundwater systems in each of the bedrock groups are sufficiently different from each other to justify the informal designation of groundwater systems based on bedrock lithology. Thus, the informal designation of the Upper zone - Colton, Flagstaff/North Horn, and Price River and the Lower zone - Castlegate, Blackhawk, and Mancos groundwater systems is adopted herein.

The majority of groundwater in the permit and adjacent areas generally occurs within isolated, perched aquifers in the upper zone overlying the coal-bearing Blackhawk Formation. In the lower zone groundwater occurs in isolated saturated zones in the Blackhawk Formation. Hydrogeologic conditions within the permit and adjacent areas are summarized below:

Upper Groundwater Zone

Colton Formation. The Colton Formation outcrops in the northeast portion of the permit and adjacent areas. This formation consists predominantly of fine-grained calcareous sandstone with occasional basal beds of conglomerates and interbeds of mudstone and siltstone. Data presented in Plates 7-1 and 7-1A and Appendices 7-1 and 7-6 indicate that 16 springs issue from the Colton Formation within the permit and adjacent areas. The elevations and location of these springs vary greatly within the formation, indicating that the springs are isolated from each other and that they are not part of one aquifer.

Waddell et al. (1986) evaluated the discharge of springs in the formation for the period of June to September 1980. The measured discharge rate generally declined during the 4-month period of evaluation. This suggests that the groundwater system has a good hydraulic connection with surface recharge and that most of the annual recharge quickly drains out of the system. The limited flow indicates that the recharge is limited to small areas above the spring and not to a deeper groundwater syustem.

Groundwater issuing from the Colton Formation has a total dissolved solids ("TDS") concentration of 300 to 600 mg/l (as measured by specific conductance and laboratory analyses of TDS). The pH of this water is slightly alkaline (7.5 to 8.1). Insufficient data are available to describe seasonal variations in these parameters.

The water is a calcium-magnesium-bicarbonate type (see Appendix 7-1). The data also indicated total iron concentrations of <0.04 to 4.89 mg/l. Total manganese concentrations ranged from <0.01 to 1.29 mg/l.

Undifferentiated Flagstaff-North Horn Formation. The Flagstaff-North Horn Formation outcrops across much of the northern and central portion of the permit area. This formation consists of an interbedded sequence of sandstone, mudstone, marlstone, and limestone. Most springs and a major portion of the volume of groundwater discharging from the permit and adjacent areas issue from the Flagstaff-North Horn Formation. According to Plates 7-1 and 7-1A and Appendices 7-1 and 7-6, 36 springs issue from the Flagstaff-North Horn Formation within the permit and adjacent areas.

Groundwater discharge rates for springs issuing from the Flagstaff-North Horn Formation are greatly influenced by seasonal variations in precipitation and snowmelt, with most discharge corresponding to the melting of the winter snow pack during the spring months. Discharge is highest following the spring snowmelt and decreases to a trickle by the fall (Appendices 7-1 and 7-6). Many springs issuing from the Flagstaff-North Horn Formation have been noted to dry up each year.

Waddell et al. (1986), found that most of the annual recharge to the Flagstaff-North Horn Formation drains out of the system within about two months, while the remainder of the annual recharge drains out prior to the next snowmelt recharge event.

The groundwater regime in the Flagstaff-North Horn Formation appears to be influenced predominantly by the combined effects of lithology and topographic expression. Because the Flagstaff-North Horn Formation forms the upland plateau of the permit and adjacent areas, this formation is capable of receiving appreciable groundwater recharge from precipitation and snowmelt.

Waddell et al. (1986) concluded that the Flagstaff-North Horn groundwater system ~~is~~consists of isolated, perched water bearing lenses rather than a continuous perched aquifer. They indicate that approximately 9 percent of the average annual precipitation recharges the Flagstaff-North Horn groundwater system and that recharge water entering the Flagstaff-North Horn Formation moves downward until it encounters low permeability lenses of shale or claystone layers in the lower portion of the formation, where almost all of the water is forced to flow horizontally to springs.

Data presented in Appendices 7-1 and 7-6 indicate that groundwater issuing from the Flagstaff-North Horn Formation has a TDS concentration range of 400 to 700 mg/l. This water tends to be slightly alkaline and, similar to conditions encountered in the overlying Colton Formation, is of the calcium-magnesium-bicarbonate type.

The data presented in Appendices 7-1 and 7-6 indicate that the total iron concentration of groundwater discharging from springs in the Flagstaff-North Horn Formation is generally less than 0.04 to 0.15 mg/l. Total manganese concentrations in Flagstaff-North Horn groundwater are generally less than 0.03 mg/l. These data do not exhibit seasonal trends.

Price River Formation. The Price River Formation consists of interbedded mudstone and siltstone with some fine-grained sandstone and carbonaceous mudstone. Within the permit area, 17 springs have been found issuing from the Price River Formation as indicated based on data presented in Plates 7-1 and 7-1A and Appendices 7-1 and 7-6. Flows from these springs are limited in quantity and generally show a seasonal decrease with time, being high in the spring and reduce to very low or dry conditions in the summer. Such fluctuations indicate that these springs originate from limited recharge areas. Therefore, these springs are also part of a series of isolated, perched saturated zones or lenses and not part a regional aquifer system. Transmissivity in the Price River Formation is estimated by Waddell (1986) to be 0.07 ft^2/day or 0.00013 ft/day. Based on specific conductance measurements collected from these springs, the TDS concentration of water issuing from the Price River Formation varies from about 750 to 850 mg/l. The water is slightly alkaline, with a pH of 7.9 to 8.9.

Lower Zone

Castlegate Sandstone. The Castlegate Sandstone consists of a fine- to medium-grained sandstone that is cemented with clay and calcium carbonate. The outcrops of this sandstone form prominent cliffs in the area. No springs were identified in this formation, suggesting that it is not a significant aquifer. The absence of springs is of great significance, since this formation is situated between the overlying Upper groundwater zone (in the Colton, Flagstaff/North Horn, and Price River Formations) and the underlying lower zone (in the Blackhawk Formation). This lack of springs indicates that there is separation between the upper and lower groundwater zones. Most likely this zone is the result of two factors: 1) clay horizons in overlying formations inhibit vertical recharge from groundwaters in the Flagstaff-North Horn Formations, and 2) the exposed recharge area of the Castlegate Sandstone is limited primarily to areas of steep cliff faces.

Blackhawk Formation. The Blackhawk Formation underlies the Castlegate Sandstone and consists of interbedded sandstone, siltstone, shale, and coal. The lower Sunnyside coal seam, to be mined by UtahAmerican, is located in the upper portion of the Blackhawk Formation.

Across the formation, with the exception of the Sunnyside Sandstone, most of the individual sandstone bodies are discontinuous. This results in areas that are saturated; i.e. sandstone lenses; and areas that are dry; i.e. siltstone and shale sections. This discontinuous nature results in the typical pattern found in the mines of the Wasatch Plateau and the Book Cliffs. For this upper portion of the Blackhawk Formation, no regional aquifer has been identified. As mining advances an isolated area of saturation (perched aquifer) is encountered by the entry or by roof bolting or fractures due to subsidence. As the water from these isolated saturated zone drains into the mine it starts at an initially high rate and over time as the limited extent of the zone is emptied, the rate of flow decreases. Some zones which are laterally

As the piezometers are completed in the same saturated zone, the piezometric surface shows that groundwater in the Sunnyside Sandstone to be moving to the northeast, into the Book Cliffs (see Plate 7-1). The gradient of the piezometric surface is approximately 0.011 ft/ft. The seasonal fluctuations between fall and spring are almost undistinguishable. Based on the tabulated data (Appendix 7-1), the fluctuation range is less than 0.5 feet between summer and fall readings. Figures 7-1 and 7-2 attempt to show these variations in contour map and piezometer hydrographs.

The water level piezometers show water levels above the lower zone containing the coal seam in area of the mine. However, as reported in the Castlegate Sandstone section, no springs or water bearing zones were identified in the spring and seep inventories or in the drilling of the water level piezometers in the formation. Therefore, indicating that the piezometer monitored zones are under pressure and that the water identified in the upper zone is perched and isolated from the lower groundwater zone.

While the water in the Sunnyside Sandstone is under pressure, there was no indication during drilling that the coal seam was saturated. Similar conditions have been identified in other mines in the Wasatch Plateau and the Book Cliffs. It is likely that the water within the Sunnyside Sandstone will not affect mining unless the confining mudstone layer is breached.

It is possible that mining will intercept some water as it progresses down dip. However, as discussed previously regarding mine water inflows to the Horse Canyon Mine, it is expected that water quantities and quality will be similar to that encountered in the Horse Canyon Mine. While some pumping is likely for water from the isolated saturated zones within the lower groundwater zone; since the water in the upper groundwater zone appears to be perched aquifers 200 to 500 feet above the coal seams, no adverse effects on usable surface sources are expected.

No springs have been identified as issuing from the Blackhawk Formation (see Appendices 7-1 and 7-6 and Plates 7-1 and 7-1A).

The quality of groundwater in the Blackhawk Formation is characterized by the water quality of data collected from inflows to the Horse Canyon Mine, which is completed in the lower portion of the Blackhawk Formation. Both mines will be completed in the same coal zone. Therefore, the quality of the water encountered in the Lila Expansion is expected to be similar to the water encountered in the Horse Canyon Mine. These data indicate that Blackhawk Formation groundwater has a mean TDS concentration range of 1400 to 2400 mg/l and is of the calcium, sodium-sulfate type. These waters an east-west trending fault zone that is located within the canyon where Big and Little Stink Springs are located, referred to as the Central Graben. These two springs are located on the southern side of the northern fault of the graben. Due to the isolated nature of this graben block, being down dropped relative to the surrounding strata, within the highly impermeable Mancos Shale, it is unlikely that these springs are connected to any other water sources within the permit area. Further, the water quality and flow of the these springs, as discussed above, also indicate an isolated nature of the waters. Based on these results, the waters from Big and Little Stinky Springs are considered are from a localized, isolated saturated zone, but not part of a regional aquifer or an extensive saturated zone.

Recharge and Discharge Relations

Recharge in the permit and adjacent areas occurs from precipitation to the exposed strata. Plate 7-1a shows the major zone of recharge. This recharge area corresponds to the outcrop and exposure of the Colton/Flagstaff-North Horn Formations. No perennial surface water streams or surface water bodies exist within the permit or adjacent areas which contribute water to the groundwater systems. The majority of infiltration is a near surface occurrence into the alluvial fills within the drainages. The deeper sediments underlying the drainages (Blackhawk and Mancos) consist of low transmissivity strata which would prohibit the vertical movement of groundwater.

Recharge rates were calculated by Waddell and others (1986, p. 43) for an area in the Book Cliffs. Waddell estimated recharge at about 9 percent of annual precipitation. Lines and others (1984) indicate the mean annual precipitation along the Book Cliffs in the area of the Horse Canyon Mines is about 12 inches, indicating a recharge rate of just over 1 inch per year.

The recharge and discharge areas for local isolated, perched aquifers in the upper zone (Colton, Flagstaff-North Horn and Price River Formations) generally lie within the drainage areas of Horse and Lila Canyons. These local systems are complex in that they are discontinuous and lenticular in nature and highly dependent on topography. Recharge water from precipitation or snowmelt enters the Colton or Flagstaff-North Horn Formations and moves downward until it encounters low permeability shale or claystone layers or lenses in the formations, where almost all of the water is forced to flow horizontally to springs. The springs exhibits substantial variability in discharge in response both to spring snowmelt events and to drought and wet years. Discharge rates as great as 20 gpm have been recorded from the springs during the high-flow season, and discharge rates as low as 1 gpm are not uncommon during late summer. The effects of the trending Entry fault in the proposed Lila Canyon area. After extensive exploration, no significant water was encountered from the east-west trending fault.

Assuming mass-balance and stable hydrologic conditions, recharge will equal discharge over the long term. The relatively rapid groundwater discharge from the upper zone formations as compared with the underlying lower zone formations suggest that the stratigraphically-higher water discharges are local and are not hydraulically connected with the lower zone. Waddell et al. (1986) conclude that the perched nature of the upper zone formations protect them from the influence of dewatering of the coal-bearing zone unless the upper zone is influenced by subsidence.

Groundwater resources in the permit area are limited due to the small surface area and low recharge rates. There is not enough base flow from groundwater discharge to maintain a perennial flow in Horse Canyon Creek or Lila Canyon.

The upper groundwater zone produces low volume spring flows from up-dip exposures of bedrock and overlying alluvium. Some spring discharges from this zone have been developed and are used for livestock and wildlife. The lower groundwater zone has very limited discharges that are used for wildlife, generally during the early spring. Based on the location of these lower zone points and the vertical separation (500 feet) between the coal seam and the points, there is no possibility of mining impacting the springs.

Due to the lenticular, discontinuous, and vertically separated water bearing zones in the upper zone, it is not possible to develop a potentiometric surface or to show water level variations within these discontinuous aquifers. As described above, the nature of the discharge from the springs with time has been identified. Also, it is not possible, due to the discontinuous nature, to map the extent of the upper water bearing zones.

724.200 Regional Surface Water Resources. The permit area exists entirely within the Horse Canyon, Lila Canyon, and Little Park Wash watersheds. The regional drainage patterns are generally north-south with steep canyons which are incised in the Book Cliffs escarpment. Stream flows within the region, generally, are the result of snowmelt runoff or summer thunderstorms. Water is not abundant as evapotranspiration exceeds precipitation.

Permit Area Surface Water Resources

generally not evident below the mine site. Only flows from summer thunderstorms upstream of the site have resulted in flows below the mine. This indicates that while surface water resources may fluctuate, the fluctuations are not great enough to change the response of the stream to overcome the hydraulic and geologic characteristics of the area.

During most years, the snowmelt peak is the highest peak flow for the drainages. Under certain circumstances, when a significant summer thunderstorm occurs over the drainages, the runoff event can be quite large.

In the area of the springs, there are sections with continuous flow, where the channel has cut into the perching layer of the spring. The flows from the springs continue a short distance downstream of the spring location; however, there is no base flow contribution within the channel itself. The only flow is a result of the spring discharge and this is absorbed by the channel fill indicating a losing stream reach. There are no indications that any ~~of the~~other reaches of Lila Canyon or Little Park Wash are perennial. Since the spring of 2000, both areas have been observed numerous times (at least quarterly) and no flow has even been noted in either drainage. Normally, this would indicate an ephemeral drainage, however, since the drainage areas are greater than one square mile and exhibit no consistent flows, they are classified by regulation as intermittent.

The ephemeral nature of the streams make it difficult to document the high and low flow periods. Generally, the seasonal flow pattern for the drainages consists of dry channels until a thunderstorm or rapid snowmelt occurs. Then there is a short duration of flow within a portion of the channel. Following the passing of the storm or melting of the snow the runoff quickly decreases and the channel is again dry until the next event.

Such an event was documented in March 05 near the monitoring station L-11-G reported in the DOGM database 05/06/05. This was flow from a snowmelt event. An attempt was made to get to the monitoring point, but the access to the site was inaccessible due to deep snow across the road up Lila Canyon. Access was available only a short distance (couple of hundred feet above the Horse Canyon Access road). A water sample was taken at the upper most point that could be accessed. This was an area that typically would have been dry with no flow. The flow recorded was 7.5 gpm and a water quality sample was taken. The data are presented in the DOGM database.

A number of perched springs do exist in the tributaries of the upper reaches of the Little Park Wash drainage; however, the flows from the springs dry-up or infiltrate into the alluvial fill of the canyons within 50 to 200 feet of the source, before reaching the main drainage channel. The springs and seeps in the area have been sampled, as indicated in this application, as part of the baseline and spring/seep inventories. Therefore, they provide an estimate of the quality of the flow within the drainages.

Precipitation in the area generally consists of either high-intensity, localized thunderstorms or area wide, frontal storms. Table 7-1A presents rainfall-runoff model simulation results of both the 6-hour and 24-hour rainfall events of the drainages in the site area, to simulate each kind of storm. Appendix

7-10, Figure 1 presents the location of the drainages for the simulation results in Table 7-1A. Appendix 7-10 also presents the simulation calculation results. These peak flow results show that for short duration events with small return periods (5 years or less), there is little or no runoff from the watersheds. Additionally, due to the localized character of the thunderstorms, the storms affect only a part of the watershed and the limited runoff that does occur is lost to channel losses (infiltration, evaporation, transpiration) within the portion of the watershed that is not affected by the rainfall event. As the return period of the storm increases, storms have greater intensity and tend to cover larger areas, which likely affects most if not all of the watershed. Therefore, flows tend to increase. Intense rainfall may cause heavy flooding, but likely only affect small areas and do not result in large volumes of runoff.

For the long duration, frontal type storms, the entire watershed is covered for each event. The frontal precipitation events tend to produce only limited amounts of flow in the local ephemeral washes for the short return periods. With the increase in the return period, the flow events tend to be larger. This is due to the contribution from the entire watershed.

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Each flow event in an ephemeral channel is separate and distinct. The stream flow is directly proportional to the amount of precipitation or snow-melt runoff, and the water quality varies greatly depending on the amount of flow. The duration of these runoff events is generally short. For thunderstorm events, the flow is generally less than a few hours. Duration of runoff from the frontal runoff events is moderate in length, generally on the order of 11 to 14 hours. Based on the end of rainfall from the watershed model simulations, the runoff would generally end within 3 to 5 hours. Therefore, if a sampler were not on-site during the event, it is unlikely that any flow would be observed.

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Table 7-1A

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES
IN THE LILA CANYON MINE AREA

Watershed ID	~~Duration (hr)~~Return Period ~~Flows~~	2yr (cfs)	~~2yr~~5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
WS1.1	6 hr	0	0	1.39	5.54	9.98	17.18
	24 hr	0.65	3.22	9.31	22.68	39.50	59.77
WS1.2	6 hr	0	0	1.21	6.43	12.77	22.18
	24 hr	0.86	3.82	9.45	20.66	33.99	49.70
WS1 Total	6 hr	0	0	2.37	11.78	22.68	38.79
	24 hr	1.50	6.62	16.96	39.59	67.46	100.70
~~WS2.16 hr0001.844.30 7.7924 hr0.170.812.5 47.9614.2324.90 WS2.26 hr0001.434.14 8.5524 hr0.180.912.5 26.4710.7017.34 WS2~~WS7 Total	~~6 hr0002.988.2016.2724 hr0.321.674.6212.4121.5636.83 WS7.16~~ hr	0	0	2.23	10.43	19.63	33.75
	24 hr	1.29	6.04	15.85	36.15	60.94	90.24
WS8~~.1~~ Total	6 hr	0	0	0.85	3.60	6.59	11.34
	24 hr	0.43	2.09	5.76	13.64	23.46	35.09

Table 7-1A

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES
IN THE LILA CANYON MINE AREA

Watershed ID	~~Duration (hr)~~Return Period ~~Flows~~	2yr (cfs)	~~2yr~~5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
WS9~~.1~~ Total	6 hr	0	0	3.46	16.17	30.46	52.36
	24 hr	2.01	9.38	24.59	56.08	94.53	139.99

Table 7-1A

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES IN THE LILA CANYON MINE AREA

Watershed ID	~~Duration (hr)~~Return Period ~~Flows~~	2yr (cfs)	~~2yr~~5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
Little Park 6.1	6 hr	0	0	1.63	6.48	11.66	20.08
	24 hr	0.76	3.76	10.88	26.5	46.16	69.84
Little Park 6.2	6 hr	0	0	0.93	3.70	6.66	11.47
	24 hr	0.44	2.15	6.21	15.14	26.36	39.89
Little Park 6 Cumulative	Text Moved Here: 1 6 hr	0	0	2.56	10.18	18.33	31.54
	24 hr	1.20	5.91	17.09	41.63	72.52	109.74
Little Park 6.3	6 hr	0	0	0.32	1.21	2.15	3.70
	24 hr	0.14	0.70	2.17	5.47	9.75	14.92
Little Park 5.1	6 hr	0	0	0.31	1.00	1.73	2.93
	24 hr	0.11	0.59	2.41	7.85	15.16	23.59
Little Park 5.2	6 hr	0	0	0.73	2.75	4.87	8.38
	24 hr	0.32	1.59	4.92	12.40	22.10	33.82
Little Park 5 End Of Moved Text Cumulative	6 hr	0	0	2.82	11.34	20.41	35.22
	24 hr	1.77	8.54	24.80	61.16	107.32	163.42
Little Park 4.1	6 hr	0	0	0.75	2.58	4.47	7.65
	24 hr	0.29	1.49	5.31	14.72	28.04	43.72

Table 7-1A

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES
IN THE LILA CANYON MINE AREA

Watershed ID	~~Duration (hr)~~Return Period ~~Flows~~	2yr (cfs)	~~2yr~~5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
Little Park 4.2	6 hr	0	0	0.76	3.01	5.42	9.33
	24 hr	0.36	1.75	5.06	12.32	21.46	32.47
Little Park 6.4	6 hr	0	0	0.23	0.86	1.53	2.64
	24 hr	0.10	0.50	1.55	3.90	6.95	10.64

Table 7-1A

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES
IN THE LILA CANYON MINE AREA

Watershed ID	~~Duration (hr)~~Return Period ~~Flows~~	2yr (cfs)	~~2yr~~5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
Little Park 6.5	6 hr	0	0	0.90	3.58	6.45	11.10
	24 hr	0.42	2.08	6.02	14.66	25.53	38.63
Little Park 4 Cumulative	6 hr	0	0	6.17	24.81	44.74	77.12
	24 hr	2.93	14.01	40.73	101.08	178.91	269.04
Little Park 6.6	6 hr	0	0	0.87	4.44	8.64	14.92
	24 hr	0.58	2.60	6.58	14.58	24.18	35.52
Little Park 3.1	6 hr	0	0	2.35	8.86	15.72	27.03
	24 hr	1.03	5.13	15.87	40.00	71.27	109.07
Little Park 3.2	6 hr	0	0	1.00	4.65	8.76	15.07
	24 hr	0.58	2.70	7.08	16.14	27.20	40.29
Little Park 3 Cumulative	6 hr	0	0	9.73	42.29	77.65	133.01
	24 hr	5.08	23.46	65.66	162.22	284.24	430.10
Little Park 6.7	6 hr	0	0	0.76	4.53	9.00	15.63
	24 hr	0.60	2.69	6.66	14.57	23.96	35.04
Little Park 2.1	6 hr	0	0	0	1.84	4.30	7.79
	24 hr	0.17	0.81	2.54	7.96	14.23	24.90
Little Park ~~6~~2.~~1~~2	6 hr	0	0	~~1~~0.~~6~~64	~~36.48~~.68	~~11~~7.15	12.~~6620.0 8~~35
	24 hr	0.~~763.761 0.88~~48	~~26.546~~2.16	~~69~~5.45	12.07	20.02	29.~~84~~40

Table 7-1A

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES
IN THE LILA CANYON MINE AREA

Watershed ID	~~Duration (hr)~~Return Period ~~Flows~~	2yr (cfs)	~~2yr~~5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
Little Park ~~6.~~2 Cumulative	6 hr	0	0	~~0.933.706.66~~11.~~47~~07	54.40	100.57	168.92
	24 hr	~~0~~6.59	29.31	80.~~44~~68	~~2~~192.1~~5~~2	~~6~~329.~~24~~11	~~15.1426.3639.89~~493.91

Table 7-1A

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES
IN THE LILA CANYON MINE AREA

Watershed ID	~~Duration (hr)~~Return Period ~~Flows~~	2yr (cfs)	~~2yr~~5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
Little Park ~~6~~ ~~Text Was Moved From Here: 1~~ ~~6 hr002.8211.34 20.4135.2224 hr1.778.5424.8061.16107.32163.42Little Park 4.16 hr000.752.584.477.6524 hr0.291.495.3114.7228.0443.72Little Park 4.26 hr000.763.015.429.3324 hr0.361.755.0612.3221.4632.47Little Park 6.46 hr000.230.861.532.6424 hr0.100.501.553.906.9510.64Little Park 6.56 hr000.903.586.4511.1024~~	6 hr	0	0	~~1~~11.56	58.64	110.~~004.6 58.76~~02	1~~5~~83.~~07~~99
	24 hr	~~0.582.707.0816.1427.2040.29 Little Park 36 hr009.7342.2977.65133.0124 hr5.0823.4665.66162.22284~~7.24	~~430.10Little Park 6.76 hr00~~31.45	84.30	199.12	~~6~~340.~~47~~37	~~14.5026.8524 hr1.144.6910.5821.7634.4849.42Little Park6 hr0010.4847.9790.92152~~508.74

~~24 hr6.1926.3470.46170.78298.11448.73~~

~~7-10 present the simulation calculation results. These peak flow results show that for short duration events with small return periods (5 years or less), there is little or no runoff from the watersheds. Additionally, due to the localized character of the thunderstorms, the storms affect only a part of the watershed and the limited runoff that does occur is lost to channel losses (infiltration, evaporation, transpiration) within the portion of the watershed that is not affected by the rainfall event. As the return period of the storm increases, storms have greater intensity and tend to cover larger areas, which likely affects most if not all of the watershed. Therefore, flows tend to increase. Intense rainfall may cause heavy flooding, but likely only affect small areas and do not result in large volumes of runoff.~~

~~For the long duration, frontal type storms, the entire watershed is covered for each event. The frontal precipitation events tend to produce only limited amounts of flow in the local ephemeral washes for the short return periods. With the increase in the return period, the flow events tend to be larger. This is due to the contribution from the entire watershed.~~

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~~There are no specified water uses for~~To determine the ~~stream flows. No water rights exist~~extent onf the ~~surface streams, due to the overall general lack~~protection of ~~flow for~~ these ~~drainages.~~ runoff waters, the downstream state appropriated waters were evaluated. As listed in Table 7-2 and shown on Plate 7-3, the downstream water rights are held by the BLM and consist of 91-2617, -2618, -2619, -2620, -2621, -2646, -2665, -4516, -4646, -4648, and -4649. As reported in Table 7-2, most of these rights have no flow and no use associated with them. According to the State Engineers web site, these rights have not yet been evaluated to determine if there is sufficient water to meet the right. Many of these rights are located on the stream and some are for stok ponds to be located off stream. However, in reviewing these locations, except for 91-2621, no stock ponds have been located in these areas. The BLM pond located at the location of water right 91-2621 had some improvement work conducted in 2004 (see Appendix 7-9). However, the BLM was not involved in the pond improvements. Recent site investigation shows that the diversion structure described in Appendix 7-9 has been breached and no flow now reaches the pond from Grassy Wash.

There are two water rights for isolated stock ponds in the head waters of Stinky Spring Canyon, 91-4648 for Dryden Reservoir located in the SE/4, SW/4, Section 14, T16S, R14E and 91-4649 for Sams Pond located in the NW/4, NE/4, Section 23, T16S, R14E (see Plates 7-1 and 7-3). Both of the water rights are owned by the BLM and have a maximum capacity of 3 ac-ft. No records have been found that these ponds were constructed. Based on the maximum capacity of the ponds, it is expected that these ponds would be about one half acre in size, assuming a depth of 5 feet. Field inspection of the quarter sections found no ponds along the ephemeral drainages and review of aerial photos of the area also did not reveal any ponds in the area. Based on the locations for the water rights, the area for water right 91-4648 is shown in a photograph presented in Attachment 1 of Appendix 7-7 (Photo 93 - Page 28). As can be seen, there is no stock pond in this area. The area for water right 91-4649 is shown in photographs taken in the area (see Figure 7-5) indicated in the water right of the pond. No pond has been found. The only thing found in the designated area is an area of grass in the pinyon juniper.

Based on water rights flow values and the lack of a specified use, it is assumed that the State Engineer and the BLM had planned to develop range improvements in the area, but the lack of water made this effort unsuccessful. Given the lack of use for these downstream channels, it does not appear that a significant concern exists for the downstream waters.

Surface waters in this part of the Book Cliffs drain to the Price River. The Price River flows to the Green River which, in turn, flows to the Colorado River. It is anticipated that only during extremely long duration, high-intensity thunderstorms that flow from the ephemeral and intermittent drainages within the permit area would reach the Price River. Due to the length of channel and the limited volume of runoff, the majority of flow is lost to channel losses, as indicated in Appendix 7-9.

Lines and Plantz (1981, p. 33) conducted three seepage surveys of Horse Canyon Creek in 1978 and 1979. The results of the surveys show no consistent trends through time. Mine discharges created difficulties in interpretation of the data because there was no indication of whether the mine was or was not discharging water at the time of the surveys. However, Horse Canyon Creek below the mine is a losing stream, due to the visual observation of low flows decreasing downstream of the mine (professional observations, Thomas Suchoski, 1979-1980 & 1984-86). Flow in the channel adjacent to the mine facility entry portal on several occasions during mine inspections during the spring period were approximately 4 to 6 inches deep, with a flow width of 15 to 20 feet. Downstream of the mine in the area of the roadside refuse pile, the flow would be 2 to 3 inches deep with a flow width of 10 to 12 feet. Channel slopes in both areas were similar. No diversions are present along this reach of the channel to reduce the flow. Therefore, the channel flow decrease is the result of infiltration and evaporation of the water within the channel.

The Lila Canyon drainage is normally dry, flowing only in response to precipitation runoff or rapid snowmelt. The mine facilities will be located in the Right Fork of Lila Canyon.

In January 2004, an assessment of the geomorphic character of the Lila Canyon channel, downstream of the proposed mine site, was conducted to address DOGM comments. A series of channel cross-section measurements were taken and the bed and bank materials visually observed. During this evaluation, it was discovered that a diversion structure had been installed just above the confluence of the Right Fork of Lila Canyon and Grassy Wash (see Appendix 7-9 and Figure 7-3). This diversion structure ~~will~~ diverted all flow from the drainage and conveyed it by diversion channel to a stock pond located in the SW/4, SW/4 of Section 28, T. 16 S., R. 14 E. Subsequently, it was ~~determined~~thought that the improvements were part of a BLM range improvement project. This structure ~~has~~ significantly modified the drainage pattern for this area. Flows that previously would have flowed into Grassy Wash ~~will~~would now be detained in the stock pond. However, in discussions with BLM personnel, it was discovered that the BLM was not involved in the pond improvements. Recent site investigation shows that the diversion structure described in Appendix 7-9 has been breached and no flow now reaches the pond from Grassy Wash.

The closest perennial stream to the permit area is Range Creek. The drainage is located approximately 6 miles east of the proposed Lila Canyon permit area boundary (see Plate 7-1a).

Range Creek is in a broad, south-southeast oriented drainage that has been eroded into the Roan Cliffs. A western extension of the Roan Cliffs (Patmos Ridge) lies between Range Creek and the Book Cliffs. The proposed Lila Canyon operation is on the west side of Patmos Ridge. The Colton Formation is exposed at the surface from Patmos Ridge east to the main body of the Roan Cliffs, and between these two escarpments Range Creek has eroded into but not through the Colton Formation. Approximately eleven miles southeast of the permit area, just upstream of Turtle Canyon, Range Creek has eroded through the Colton, Flagstaff, and North Horn Formations, but it reaches the Green River without having eroded through the Upper Price River Formation. The nearest Blackhawk outcrop is 10 miles further south, along the Price River.

recharge to move laterally through the Colton Formation and reach the Range Creek drainage, to be about 8,700 to 11,300 years.

As a result of the five to six miles horizontal distance from proposed permit area to Range Creek (see Plate 7-1a) and the isolating effects of the over 1,000 feet of low-permeability, isolating strata between the coal seam and the creek elevation (see Plate 7-1B and Table above) and the limited potential impact of subsidence damage to the recharge area, it is not likely that the Lila Canyon Mine will adversely effect Range Creek. Due to these conditions, no baseline or other sampling has been gathered nor is anticipated on Range Creek.

Additional concerns have been raised regarding the potential impact that water extracted from the Blackhawk Formation as a result of the mining activities would have on the downstream drainages, specifically the Price and Green Rivers. Initial evaluation indicates that the distance within the Blackhawk Formation between the mine and the Price River is over 12 miles. This distance alone would preclude any significant impact.

As further evidence, as discussed in Appendix 7-3, it is difficult to determine the amount of water that will be extracted by the mining activities. For design purposes, DOGM has required that a value of 500 gpm be used. This is thought to be very conservative. If this volume were extracted, the yearly total would be about 800 ac-ft per year. As there are no significant springs that discharge from the Blackhawk Formation, the loss of this flow would be minimal. Also, as discussed in Appendix 7-3, the addition or loss of this flow would result in a 0.9% flow change to the Price River and a 0.02% flow change to the Green River. In both cases, this flow change would be less than could be measured by standard methods.

The Horse Canyon drainage is monitored in accordance with the approved monitoring plan for the permit. There ha~~ve~~s been ~~no~~only one sample~~s~~ taken in the Lila Canyon ~~or~~and no samples taken in Little Park Wash ~~drainages~~ because ~~no~~only limited flow has been observed during the monitoring activities. Factors that contribute to the lack of data are: accessibility to the sites during the winter period and immediately after summer rain storm events is generally not possible, due to safety issues and a physical lack of flow. Concerns have been raised that evidence of flow has been seen in the drainages over the course of the year, therefore, why hasn't a water quality sample been collected. The following sections address the concerns of access and safety, physical lack of flow, and monitoring methods.

Access and Safety. Safety issues have hampered field work on several projects in the area. When the soils in the area get wet from a light rain, that would not generate a flow event, they become very slick and pose access and safety issues. During the IPA drilling, EarthFax had significant difficulty in getting equipment and vehicles up and down the access road following several small rain storms. In one case, they had one of their vehicles slide into the embankment rocks along the Horse Canyon access road (drop in the area was about 400 feet).

~~A~~In the conditions of heavier rains, access during rainstorms through the channels in the area is dangerous. During the avian study for the Westridge mine, Mel Coonrod (EIS) and Frank Howe (DWR) were caught in a channel during a rainstorm and lost their vehicle to flooding. This occurred on Nine Mile Creek at the ~~d~~Dry ~~c~~Canyon crossing in March or April of 2000. Conditions in this drainages are similar to drainages within the Lila Canyon Permit Area.

During winter and early spring periods, there have been times when the access road has been blocked with several feet of snow making access with the field equipment impossible.

UAE's position is that collection of environmental data is not worth of the loss of life or limb. Therefore, when the conditions are unsafe, the site is labeled inaccessible. At all other times, the sites are visited and if no flow is encountered it is reported as such.

Physical Lack of Flow. The lack of flow data in the sampling effort is not a failure of the sampling effort. The lack of flow at these sample sites is data which documents the normal conditions in the site area. If the streams were flowing 50 percent of the time, it is likely that the sampling efforts would encounter flow on an infrequent basis. However, if the flow for the short return periods is extremely small or none existence, it will be difficult to obtain and provide samples of these events. This lack of flow shows that the drainages do not have a base flow component and there is no regional aquifer discharging to the deeply incised canyons and drainages in the area. The sequence of sampling efforts have demonstrated further, that there are no long-term flow events occurring in the mine permit area or adjacent areas. Also, spring photographs show disturbances in the stream channels from the previous fall period sampling efforts, indicating that for some years no flow occurred from the fall to spring measurement events. Additionally, the peak flow simulation results presented in Table 7-1A show that for small return periods, 2 to 5 year events, runoff flows are not expected and that the duration of any flow events would be of extremely limited duration.

Therefore, a pattern has been identified of a set of drainages that only flow in direct response to precipitation or rapid snow melt. The flow events are localized, sporadic events with no consistent sequence and timing and are extremely limited in duration. For ephemeral drainages in the area, these are the variations and distributions in flow that can be expected and are seen at other mines. Under the definitions in the rules, the seasonal variation would then be the isolated snowmelt in various reaches of the channels in the spring period, and the isolated peak flow from a thunder storm that would have enough intensity to result in a runoff event. Based on the runoff simulations in Table 7-1A, for the larger precipitation events, the flows can be significant.

U.S. Steel conducted water quality monitoring of the Horse Canyon drainage. These monitoring efforts were conducted prior to the development of DOGM's present Water Monitoring Guidelines, and as a result the data is quite limited. The most recent results of these water monitoring efforts are presented in Appendix 7-2 and historic results are included in the DOGM electronic database.

The data collected from Horse Canyon follows the same pattern documented by Waddell, et.al. (1986). The pattern shows that the TDS concentrations for surface waters on the lower Blackhawk and out onto the Mancos Shale range from 1000 mg/l and increase to 2,000 to 2,500 mg/l. Additionally, the highest concentrations of suspended sediment will occur during high-intensity runoff from thunderstorms, and the lowest concentrations will occur during low flow or snow melt events.

Therefore, because of the similarity of the water quality data, the water quality expected from the drainages in the area of the proposed mine will be similar to the water quality found in the Horse Canyon drainage.

Monitoring Methods. Monitoring efforts did not include remote or automatic sampling efforts because of inherent problems attempting to implement these methods for this application. It has been suggested that crest-staff gauges, single-stage samplers, ISCO instruments, etc. could be used to collect samples. These are methods that the USGS uses for developed remote sampling sites. However, none of the UEI sampling sites are developed. In the case of crest gauges, for these methods to be reliable and feasible, the sites need to be developed with concrete or bedrock lined channel sections. For the channel configurations at the UEI sites, the channel bottoms generally consist of movable beds. These are channels that change configuration from storm to storm. As a result of channel erosion and deposition, the stage discharge relationship of the channel changes with each storm event. Therefore, while the

Arizona conditions, similar difficulties and problems will be encountered and the data will have the same difficulties.

Several samplers were installed as apart of the Westridge Mine sampling efforts. The samplers have problems with plugging and malfunctions on a regular basis and need constant maintenance. They are still in use, because they were required, however, the data are of limited value (Karla Knoop, personal communication, 2006). Single stage and automatic samplers were also installed as part of the Smoky Hollow baseline data collection efforts. Similar maintenance and malfunction problems were identified as part of the Smoky Hollow sampling efforts (Richard White, personal communication, 2006).

Radio Frequency telemetry (RF) sensing equipment has also been considered. However, as most of the monitoring sensors require line of sight and these sites are in remote, incised canyons or drainages, that was not considered a viable option.

As a result of these difficulties, it was determined that these methods would not provide any better data than was already being collected. The concerns with what conclusions erroneous or questionable data would generate versus limited good data lead to the decision that these methods would not be used.

724.300 Geologic Information Detailed geologic information of the permit and adjacent areas is included in Section 600, with specific strata analyses, as required, in Section 624.

724.310 Probable Hydrologic Consequences. The geologic data indicate that no toxic- or acid-forming materials are known to exist in the coal or rock strata immediately below or above the seam (see Section 624.300). The probable hydrologic consequences of the proposed operation will be discussed in Section 728 and Appendix 7-3 of this application.

724.320 Feasibility of Reclamation. The geologic data in Section 600 provides sufficient detail to allow: the evaluation of whether toxic- or acid-forming materials are expected to be encountered in mining; subsidence impacts; whether surface disturbed areas are designed to be constructed in a manner that will allow for reclamation to approximate original contour; and whether the operation plans have been design to ensure that material damage to the hydrologic balance does not occur outside of the permit area. These issues are evaluated in the R645 rules and discussed in Section 728 of this application.

where the permit area or adjacent area includes a stream which meets the requirements of R645-302-320.

725. Baseline Cumulative Impact Area Information

725.100 Hydrologic and Geologic Information Hydrologic and geologic information for the mine area is provided in Sections 600, 724 and in the PHC Determination in Appendix 7-3. This information includes the available information gathered by the applicant. Additional information is available for the areas adjacent to the proposed mining and adjacent areas from state and federal agencies.

725.200 Other Data Sources As indicated above, additional information is available for the cumulative impact area. In addition to the base line data for the proposed mining, additional pertinent hydrologic data is available from adjacent mines and permits and government reports.

725.300 Available Data Necessary hydrologic and geologic information is assumed to be available to the Division in this P.A.P.

726. Modeling Where ever possible actual surface and ground water information is supplied in this application. However, the following models were used to supplement the data.

Storm 6.2, a program to calculate runoff flows was used to calculate runoff from some disturbed area drainage areas.

Hydroflow Hydrograph program by Intelisolve was used to simulate the runoff and routing from the undisturbed drainages above the proposed mine. As discussed in Section 724.200 of the MRP, the flow simulations provide an understanding of the types and kinds of flow responses that can be expected from the watersheds of the proposed mine area.

A simulation of transmission losses to determine potential impacts from mine water discharge to the Price River and fishery was completed using a spreadsheet based on the NRCS channel loss evaluation.

727. Alternate Water Source Information A search was conducted of the State of Utah Water Rights files for all rights occurring within, and adjacent to, the permit area for a distance of one mile. The location of those rights are shown on Plate 7-3, based on the location provided for the water right. A description of each of the rights, including the name of the water right owner, point of diversion, source of the water, along with the allotted flow and the designated use of the water is tabulated in Table 7-2. Due to the limited volume of water available, the condition of most of the spring and stock pond facilities is very poor. Based on the water rights, for the area of the mine, the use is limited to stockwatering of less than 250 animal units.

controlled by a system of ditches and culverts which will convey all disturbed area runoff to a sediment pond for final treatment prior to discharge.

This permit application includes a plan, with maps and descriptions, indicating how the relevant requirements of R645-301-730, R645-301-740, R645-301-750 and R645-301-760 will be met. Each of these sections are addressed in this Chapter, along with relevant Maps and Appendices.

731.100 Hydrologic-Balance Protection

731.110 Ground-Water Protection In order to protect the hydrologic balance, coal mining and reclamation operations will be conducted according to the plan approved under R645-301-731 and the following:

731.111 Ground-Water Quality Ground-water quality will be protected by the plan described in Section 731 and the following:

(1) Minimizing surface disturbance and proper handling of earth materials to minimize acidic, toxic or other harmful infiltration to ground-water systems. Appendix 6-2 of the MRP presents acid and toxic results from a series of roof and floor samples from the areas north and south of the proposed mine. The samples of the S-24 and S-25 drillholes show the quality of the roof and floor strata located to the south of the proposed operation, while the Lila Fan Portal roof and floor samples show the quality of the strata north of the proposed mine. These samples identified only minor issues with one or two samples for revegetation issues. The recommendations were that these samples would not be a problem when mixed with the surrounding rock. No acid conditions were identified in any of the rock samples. As these samples bracket the mine property and the quality is similar to quality found at other mines along the Book Cliffs and none of these mines have an acid or toxic issue, then it is likely that the rock in the proposed mine area will have the same characteristics.;

harmful infiltration to ground-water systems. Appendix 6-2 of the MRP presents acid and toxic results from a series of roof and floor samples from the areas north and south of the proposed mine. The samples of the S-24 and S-25 drillholes show the quality of the roof and floor strata located to the south of the proposed operation, while the Lila Fan Portal roof and floor samples show the quality of the strata north of the proposed mine. These samples identified only minor issues with one or two samples for revegetation issues. The recommendations were that these samples would not be a problem when mixed with the surrounding rock. No acid conditions were identified in any of the rock samples. As these samples bracket the mine property and the quality is similar to quality found at other mines along the Book Cliffs and none of these mines have an acid or toxic issue, then it is likely that the rock in the proposed mine area will have the same characteristics. Also, the rock from the access tunnels will be similar to the rock samples for the floor;

(2) Testing (as-necessary) to ensure stockpiled materials are non-acid and non-toxic;

(3) Controlling and treating disturbed area runoff to prevent discharge of pollutants into surface-water, by the use of diversions, culverts, silt fences, sediment ponds, and by chemical treatment if necessary;

(4) Minimizing and/or treating mine water discharge to comply with U.P.D.E.S. discharge standards;

(5) Establishing where surface-water resources exist within or adjacent to the permit area through a Baseline Study (done) and monitoring quality and quantity of significant sources through impletation of a Water Monitoring Plan (proposed);

(6) Proper handling of potentially harmful materials (such as fuels, grease, oil, etc.) in accordance with an

filing. In the spring and seep inventories there has never been any flow identified in the area of 91-2517 as the site is located off of the stream channel. It is assumed that the filing for 91-2517 is a duplicate but the location is wrong. There have been numerous seep/spring notations in the local area, but the only consistent flowing site is 91-2539; this is the site that will be monitored for Pine Spring. In a recent archeological study, the location of the sight that has been monitored as L-9-G was determined using GPS coordinates. The location for this site was determined to be different than what was plotted on the Plates 7-1, 7-1A, and 7-3. Based on this new data, the location of the spring has been updated.

L-10-G is also an unnamed spring that matches Earthfax sample site 14. Since this site is located over 1 mile south of the permit area, it has been replaced with L-12-G which is a more appropriate site to monitor. Monitoring of site L-10-G will be suspended as of the First Quarter of 2003.

L-11-G is located in the bottom of the upper reaches of Lila Canyon. This is in the same drainage as the Mont and Leslie Springs water right locations. In recent years L-6-G (H-18) has been dry. However, there has been some minimum flow observed approximately one hundred yards above L-6-G where L-11-G was established.

L-12-G is an unnamed spring which had been developed but is now abandoned. The seep/spring inventory data is shown in Appendix 7-1 and locations are shown on Plate 7-1. Proposed water monitoring sites are shown on Plate 7-4.

L-13-S, L-14-S, and L-15-S are sites being monitored to assist in characterization of the various drainages.

L-16-G and L-17-G are seeps being monitored in Stinky Spring Canyon. These sites were not identified during baseline surveys and are believed to exist intermittently and are not always evident. These two seeps appear to be an important source of water for Bighorn sheep specifically in the early spring.

Table 7-3 Lila Canyon Mine Water Monitoring Stations				
Station	Location	Type	Frequency	Remarks
L-13-S	Little Park Wash	Dry Wash	Monthly	At Road Crossing
L-14-S	Section 25 Wash	Dry Wash	Monthly	At Road Crossing
L-15-S	Williams Draw Wash	Dry Wash	Sampling Suspended 1Qtr of 2003	At Road Crossing
L-16-G	Stinky Spring Wash	Seep	Quarterly	Top of Mancos
L-17-G	Stinky Spring Wash	Seep	Quarterly	Top of Mancos
L-18-S	Stinky Springs Wash	Dry Wash	Monthly	Adjacent to Access Road
L-19-S	Little Park Wash	Dry Wash	Monthly	At Permit Boundary
IPA-1	Little Park	Borehole	Quarterly	Water Level Only
IPA-2	Little Park	Borehole	Quarterly	Water Level Only
IPA-3	Little Park	Borehole	Quarterly	Water Level Only

NOTE: Sites L-13-S, L-14-S, L-15-S, and L-18-S will no longer be monitored after the washes have been characterized.

731.521 Portal Location The proposed access portals are below the coal outcrop, as shown on Figure 7-1, Plates 5-5 and 7-5. The fan is to be located above, at the outcrop. The rock slopes will slope up to the east at approximately 12% to contact the coal seam; however, the coal seam is dipping down to the east in this area. The approximate point of contact between the rock slopes and the coal seam will be 1227' from the surface at an elevation of 6300'. Ground water levels in the mining area, based on the 3 water monitoring

holes and other geologic data, appear to be nearly static at elevation 5990 in this area (see Figure 7-1).

Water level in the mine would have to raise approximately 310' to reach the rock slope/coal seam contact and result in a gravity discharge. Water monitoring results and other historical data in the area do not indicate this is likely to occur.

731.522 Surface Entries after January 21, 1981 This is not known to be an acid-producing or iron-producing coal seam; however, proposed portals are located to prevent gravity discharge from the mine (see Section 731.521).

731.600 Buffer Zones All streams within the permit area are either ephemeral or intermittent by rule with ephemeral flow. ~~As such, buffer zones are not required; however, to provide additional protection~~In the area of the surface facilities along the intermittent by definition Lila Wash, the Operator will install stream buffer zone signs in locations shown on Plate 5-2 and maintain the buffer zones during the operation.

731.700 Cross Sections and Maps The following is a list of cross-sections and maps provided in this section of the P.A.P.

Plate 7-1 Permit Area Hydrology Map

WordPerfect Document Compare Summary

Original document: C:\Lila\Correspondance\2006\Submittals\06-016 Final Deficineices\Appendix 7-3 06-007.wpd
Revised document:
@PFDesktop\:MyComputer\C:\Lila\Correspondance\2006\Submittals\06-016 Final Deficineices\Appendix 7-3-06-016.wpd
Deletions are shown with the following attributes and color:
~~Strikeout~~, Blue RGB(0,0,255).
Deleted text is shown as full text.
Insertions are shown with the following attributes and color:
Double Underline, Redline, Red RGB(255,0,0).

The document was marked with 30 Deletions, 58 Insertions, 0 Moves.

Appendix 7-3

Probable Hydrologic Consequences Determination

Updated ~~February~~November 2006

UTAH REGISTERED PROFESSIONAL ENGINEER
#152606
R. Jay Marshall

Probable Hydrologic Consequences Determination

General

The best available adjacent area data to assist in making a determination of probable hydrologic consequences of the proposed operation comes from the adjacent Horse Canyon Mine, and Columbia Mines. The Columbia Mine has been closed since the late 1960's, and the Horse Canyon Mine has been closed since the mid-1980's. The Horse Canyon Mine has also been reclaimed under SMCRA.

Data gathered from these mines and the surrounding hydrologic regime has been used in this determination, as well as baseline data gathered in the area of the proposed Lila Canyon Mine Extension.

Pertinent water monitoring data for the Horse Canyon Mine and Lila Canyon Extension ~~is~~are included in Appendices 7-1, 7-2, and 7-6 of this application and Appendix VII-1 of the Horse Canyon MRP. Additional recent monitoring data are~~a~~ available from the DOGM electronic database. Baseline geologic information is presented in Chapter 6 of this P.A.P. Baseline hydrologic information~~ is~~, descriptions of the function of the streams and groundwater systems, and discussions of various issues regarding the data are presented in Sections 724.100 and 724.200 of this P.A.P. To ensure that this document addresses these issues, these data, descriptions, and discussions are referenced and should be considered a part of this document.

Mining in the Horse Canyon area began in the late 1930's. Detailed hydrologic information was first gathered in the late 1970's. It is impossible to precisely describe the area's pre-mining hydrology due to the adjacent historical mining. The conditions represented by these data help to define the hydrology about the time SMCRA was passed.

Analysis of Data

Potential impacts of coal mining on the quality and quantity of surface and groundwater flow may include:

- Contamination from acid- or toxic-forming materials;
- Increased sediment yield from disturbed areas;

- Increased total dissolved solids concentrations;
- Flooding or stream flow alteration;
- Impacts to groundwater or surface water availability;
- Hydrocarbon contamination from above ground storage tanks or from the use of hydrocarbons in the permit area;
- Contamination of surface and groundwater from road salting; and
- Contamination of surface water from coal spillage due to hauling operations.

Potential Impacts to the Hydrologic Balance. Potential impacts of the Lila Canyon Mine on the hydrologic balance of the permit and adjacent areas are addressed in the following sections:

Acid- or Toxic- Forming Materials. Information on acid-and toxic-forming materials is presented in Chapter 6. These data show that no acid- or toxic-forming materials are present ~~at~~to the north or south of the Lila Canyon Mine. Given the Lila Canyon Mine will be opened in the same strata as has been disturbed to the north at the Horse Canyon Mine and the Boreholes S-24 and S-25 to the south, no impacts from Acid or Toxic forming materials are anticipated.

Additionally, rocks of the Mesa Verde Group are carbonaceous, resulting in persistence of acids and related toxins in water in the mine and adjacent strata unlikely. Also, the design of the refuse pile will prevent any acid or toxic potential from material removed from the mine. Based upon the hydrology, geology, and climate of the area probability of acid or toxic impacts from materials removed from the mine or from mine water discharge is unlikely. Thus, no significant potential exists for the contamination of surface and groundwater in the permit and adjacent areas by acid- or toxic-forming materials.

Sediment Yield. The potential impact of mining and reclamation on sediment yield is an increase in sediment in the surface waters downstream from disturbed areas. Sediment-control measures (such as sedimentation ponds, diversions, etc.) will be installed to minimize this impact. These facilities will be regularly inspected (see Section 514) and maintained to ensure that they remain in proper operating condition.

The implementation of sediment control measures are mandated to minimize the erosion hazard associated with mining operations. Argument has been presented that reducing the sediment load, while the sediment carrying capacity of the stream remains the same, can result in increased stream bed and stream bank erosion. This would be true, if the flow rate released to the stream remained the same. However, the use of sediment control structures results in the peak flow released from the site ~~to be~~being reduced to a controlled rate which is less than the natural peak flow. Therefore, the sediment carrying capacity of the stream is correspondingly reduced. Additionally, the duration of the lower rate controlled release from the sediment control structures aids in enhancing the development of vegetation along the stream banks ~~aiding in the~~which provides additional stabilization of the channel banks and bed. While ~~these~~the bed and bank impacts are not anticipated, the applicant has agreed to monitor the conditions of the channel downstream of the site for geomorphic and erosional change as a result of mine discharges.

All construction and upgrading activities will be undertaken during periods of dry weather, commencing in late spring and lasting through fall. For both the mining and reclamation periods, it is expected that construction, upgrading, or regrading activities would cause an increase in sediment load to the stream. Temporary sediment controls will be used whenever possible to lessen the impact of construction activities.

Stream buffer zones have been delineated upstream and downstream of the disturbed area of the mine facilities. These buffer zones will aid in ensuring that no disturbance occurs within the area of the unprotected channel. While these buffer zones are planned and will be installed and maintained for the intermittent by definition stream, it should be recognized that the reach of the channel that is being protected is ephemeral in nature and not an intermittent or perennial nature reach (see Appendix 7-6 for characterization of streams).

Subsidence tends to cause a warping or sagging of the surface in the area of the mined out area. Within the stream channel that crosses a subsided area, at the upstream boundary of the subsidence, the stream channel is steepened, resulting in the potential for additional erosion in the steepened reach. As the stream crosses the sagged subsided area, the channel gradient decreases below the pre-subsided slope. This results in increased glides and extended pools in intermittent and perennial streams or areas of increase deposition in ephemeral streams. Subsidence cracks which intersect stream channels with steep gradients could, for a short period of time, result in a local increase in the sediment yield of the stream. However, this sediment increase would also cause the crack to quickly fill, recreating pre-subsidence stream channel conditions. Thus, the potential impact to sediment yield from subsidence in the permit area would be minor and of short duration.

Various sediment-control measures will be implemented during reclamation as the vegetation becomes established. As discussed in Section 542.200 of this P.A.P., these measures will include installation of silt fences and straw-bale dikes in appropriate locations to minimize potential contributions of sediment to the Right Fork of Lila Canyon. These measures will reduce the amount of erosion from the reclaimed areas, thereby precluding adverse impacts to the environment.

Acidity, Total Suspended Solids, and Total Dissolved Solids. Probable impacts of mining and reclamation operations on the acidity and total suspended solids concentrations of surface and groundwater in the permit and adjacent areas were addressed previously in this section. Since the proposed Lila Canyon Mine has not started, there is no specific data available on Lila mine water. Therefore, quality information ~~was~~ obtained from the adjacent Horse Canyon Mine workings was used to be representative of the water quality expected in the Lila Canyon Mine. This is due to the mines being adjacent to each other and the same geologic strata being mined.

Data presented in Appendices 7-1 and 7-6 and summarized in Section 724.100 of this P.A.P. indicate that the TDS concentration of water in the Blackhawk Formation (as measured in inflow to the nearby Horse Canyon Mine) ranged from approximately 1400 to 2400 mg/l and is of the sodium-bicarbonate type. As noted in Section 724.200, the TDS concentration of water in the Right Fork of Lila Canyon is unknown, but likely to be similar to the flows in Horse Canyon Creek which are in the range from 1200 to 1500 mg/l. This comparison is justified due to the similar exposures of strata that both streams flow across and the similarity in the watershed conditions. The dominant ions in this water are calcium and bicarbonate during high-flow periods, whereas the dominant ions during low-flow periods are sodium, magnesium, sulfate, and bicarbonate.

These data suggest that the TDS concentration of water in the Right Fork of Lila Canyon can be expected to increase by a factor of 1.5 for the water discharged from the mine to the drainage. This concentration is similar to concentrations found in other streams along the Book Cliffs are described by Waddell, et. Al. (1986). It should be noted that it is anticipated that the Lila Canyon Mine will use powdered limestone or dolomite (i.e., calcium-magnesium-carbonate) for rock dust. It is not anticipated that gypsum rock dust (calcium-sulfate) will be used in the mine. Hence, dissolution of rock dust by water in the mine should not influence the chemical type of water in the drainage if mine water is discharged to the Right Fork of Lila Canyon.

As indicated in the P.A.P., the total iron and manganese concentrations in potential discharges from the mine are not significantly elevated to an effect downstream uses. Also, as discussed in Appendix 7-9, the worst case mine water discharge rate specified by the Division is expected to affect only ~~the~~a distance of 3.4 miles downstream from the mine.

Lila Canyon drainage, as part of the lower Price River basin, is classified according to Section R317-2-13 of the Utah Administrative Code (Standards of Quality for Waters of the State) as a class 2B (secondary contact recreation use), 3C (nongame fish and other aquatic life use), and 4 (agricultural use) water. No TDS standards exist for class 2B and 3C water. The TDS standard for class 4 water is 1,200 mg/l. Hence, if discharges occur from the Lila Canyon Mine to the Right Fork of Lila Canyon, the data indicate that the TDS concentration of these discharges will slightly exceed the agricultural use water-quality standard.

As there is limited agricultural use in the area, this TDS exceedance is not considered significant. The major usable water resources in the area that could potentially be affected are springs and ephemeral channels. These water sources are used by wildlife and livestock. Most of these sources are locate upstream of the proposed discharge point. Therefore, there would be no impact to these existing sources. Additionally, the quality of water discharge from the mine is expected to be significantly better than the other waters which occurs from the Mancos Shale which downstream agriculture currently uses (TDS ranging from 2200 to 4800 mg/l).

Concerns have been raised that there might be impacts of increased salinity from the solution of salts from the Mancos Shale. While it is likely that a small increase in TDS from salts picked up from the Mancos Shale, this is not expected to be a significant problem. Appendix 7-9 includes a calculation of how far a worst case mine discharge of 500 gpm would be expected to flow. This flow rate is thought to be higher than the expected discharge amount, but it does provide a worse case estimate. Because of infiltration, evapotranspiration, and diversion runoff from the channel to which the mine would discharge~~s~~ to a stock pond, the mine discharge affect is limited to a distance of 3.4 miles and is not expected to reach the Price River. Therefore, it is not expected that any salinity increase would affect downstream waters.

It should also be noted that the dissolved iron standard for class 3C water is 1.0 mg/l. No dissolved iron standard exists for class 2B or 4 waters. The data presented above indicate that potential discharge water from the mine will not exceed the dissolved iron standard of Lila Canyon. No standards exist in the R317 regulations for total iron, dissolved manganese, or total manganese. However, the data presented above indicate that potential discharges from the mine to the Right Fork of Lila Canyon will meet the effluent limitations of 40 CFR 434.

No hydrologic impacts have been noted at the adjacent Horse Canyon Mine due to subsidence. Although tension cracks may locally divert water into deeper formations, resulting in increased leaching of the formation and increased TDS concentrations, the potential of this occurring is considered minimal. This conclusion is based on experience at the Horse Canyon Mine and on the fact that the shale content of the North Horn Formation, the Price River Formation, and the Blackhawk Formation should cause these subsidence cracks to heal quickly where they are saturated by groundwater flow. Thus, potential impacts on TDS concentrations would be minor and not of significant concern.

Flooding or Streamflow Alteration. Runoff from all disturbed areas will flow through a sedimentation pond or other sediment-control device prior to discharge to the Right Fork of Lila Canyon. Three factors indicate that these sediment-control devices will minimize or preclude flooding impacts to downstream areas as a result of mining operations:

1. The sedimentation pond has been designed and will be constructed to be geotechnically stable. Thus, the potential is minimized for breaches of the sedimentation pond to occur that could cause downstream flooding.

2. The flow routing that occurs through the sedimentation pond and other sediment-control devices reduces peak flows from the disturbed areas. This precludes flooding impacts to downstream areas.

3. By retaining sediment on site in the sediment-control devices, the bottom elevations of the Right Fork of Lila Canyon downstream from the disturbed area will not be artificially raised. Thus, the hydraulic capacity of the stream channel will not be altered.

The volume of streamflow will increase in the Right Fork of Lila Canyon if water is discharged from the mine to the drainage. Potential impacts to the drainage channel could include the displacement of fines on the channel bottom, and minor widening of the channel. However, the degree of widening will likely be minimized by the increased vigor and quantity of vegetation which will be sustained along the stream channel by the increased availability of water. In particular, it is anticipated that a phreatophyte streambank vegetative community will develop as a result of mine-water discharges. This effect will occur for the distance downstream that surface flows can be sustained above channel transmission losses. Based on the maximum anticipated estimate of mine water discharge, it is unlikely that any flooding will occur to the downstream channel as the flow (1.1cfs) is significantly below the anticipated 2-year flood (37 cfs) (see Appendix 7-9 and 7-10 for discussion of the flow simulations). Care will be taken during discharge of this water to avoid erosion at the discharge point or flooding of downstream areas. Once mining ceases, the mine will be sealed and no discharges will occur. The streamflow in the Right Fork of Lila Canyon will then return to pre-mining discharge levels. Downstream impacts from such discharge will be limited to the establishment of riparian area along the stream channel. The flow are expected to be below the flow threshold to result in changes to the stream channel.

Following reclamation, stream channels which have been altered by mining operations will be returned to a stable state (see Section 762.100). The reclamation channels have been designed to safely pass the peak flow resulting from the 10-year, 6-hour or the 100-year, 6-hour precipitation event as appropriate for the channel and in accordance with the R645 regulations. Thus, flooding in the reclaimed areas will be minimized. Interim sediment-control measures and maintenance of the reclaimed areas during the post-mining period will preclude deposition of significant amounts of sediment in downstream channels following reclamation, thus maintaining the hydraulic capacity of the channels and precluding adverse, off-site flooding impacts.

Subsidence tension cracks that appear on the surface will increase the secondary porosity of the formations overlying the Lila Canyon Mine. During the period prior to healing of these cracks, this increased percolation will decrease runoff during the high-flow season (when the water would have rapidly entered the stream channel rather than flowing into the groundwater system). During low-flow periods, the result of this increased percolation will be an increase in the base flow of the stream. Hence, the net result will be a decrease in the flooding potential of the affected stream.

An additional flooding issue is the potential for flooding of the mine following mining and the discharge of water from the portals. Since the regional geology and hydrologic regimes of the Horse Canyon and Lila Canyon Mines are so similar, data has been extrapolated from the Horse Canyon Mine to the proposed Lila Canyon Mine. The proposed Lila Canyon Mine portals are located up-dip from areas in the mine where water may be expected; therefore, include both decreased and increased stream flows and spring discharges caused by mine-related subsidence, bedrock fracturing, and aquifer dewatering. These potential impacts are discussed below.

Potential for Decreased Spring and Stream Flows

To date, while surface subsidence has been identified as a result of coal mining in the nearby Horse Canyon Mine, no impact or disruption of spring and seep o~~f~~r stream flows have been identified. Bedrock fracturing routinely occurs, depending on the overburden thickness, in the rock units overlying mined coal seams. As discussed in the MRP, section 724.100, the groundwater zones in the proposed mine area is divided into two zones. The upper zone consists of discontinuous, localized perched zones which are separated vertically from the coal or any deeper groundwater bearing zone. This zone is monitored by the spring sampling. The deeper zone of groundwater consists of the Sunnyside sandstone underlying the coal seam. This zone contains groundwater that is under pressure and is the zone monitored by the monitoring wells. Given the limited number of springs and limited groundwater resources of the Castlegate Sandstone and Blackhawk Formations in the permit and adjacent areas, there is essentially no connection between the upper and lower zones. Therefore, subsidence or fracturing would affect the hydrologic balance in the area only if zones of increased vertical hydraulic conductivity were created which extended through the Price River Formation into the North Horn-Flagstaff and Colton Formations.

When subsidence occurs as a result of mining, there are four zones that occur above the mined out area. As shown in Figure 1, the zones are: a caved zone that occurs in the 6 to 10 times the thickness of the coal seam, a fractured zone which occurs 10 to 30 times the thickness of the coal seam, and deformation zone which occurs 30 to 60 times the thickness of the coal seam, and finally, a soil zone which occurs on the ground surface. Damage to surface and groundwater resources generally occur in the caved and fractured zones. Little or no damage occurs in the deformed zone. With only localized effects felt in the soil zone. As discussed in Section 525.120, the strains for the rock in the proposed mine area, as a result of mining, should limit subsidence deformation to those areas where the overburden is less than 630 feet.

Where surface disruption or cracks appear, the general mechanism is extension of the soil mantle. Natural processes will heal these crack over time. Runoff and snowmelt will wash sediments into the crack and fill any voids created. As this process progresses, the crack disappear and the surface runoff and snowmelt return to normal courses. In the Wasatch Plateau and Book Cliffs area, the clays in the area are expansive and tend to seal these cracks very rapidly. Sidel, et.al. (1996) found that minor surface changes in the area of Burnout Creek recovered within two years.

As indicated in Figure 7-4 of the PAP, the majority of the identified springs and seeps are located outside of the maximum limits of subsidence. Therefore, the potential impact is significantly reduced. Where springs are located within the maximum limits of subsidence (L-9-G), the overburden thickness is estimated to be greater than 1500 feet. Therefore, in these areas, subsidence strains, as described in Section 525.120, will not be enough to result in surface rupture or deformation. Thus, potential impact to the springs within the area of subsidence is not expected.

Concerns have been raised regarding the potential impact from subsidence on state appropriated water in the Right fork of Lila Wash, Stinky Wash, and Water rights 91-2617 through 91-2621. As discussed in the MRP, Section 724.200, these water rights have no flow and many have no use designated. While 91-2621 has a stock pond, many of the other water rights do not have a stock pond. Therefore, there is limited water storage to be protected. Also, as described above, subsidence is not expected to decrease the stream flows from the proposed mine area. As part of the subsidence monitoring plan, the area of the streams will be visually inspected during periods of 2nd mining and 3 month after to determine if any impacts occur. If impacts are identified, the mitigation plans described in Chapter 5 will be implemented.

Several lines of evidence suggest that mining-related subsidence and bedrock fracturing have not resulted in decreased stream flows or groundwater discharge in the vicinity of the nearby Horse Canyon Mine. Although considerable seasonal and climatic variability are noted in the hydrographs of springs in the permit and adjacent areas, data for both Horse Canyon Creek and springs which overlie the Horse Canyon Mine workings do not show discharge declines which may be attributed to either subsidence or bedrock fracturing (see Appendices 7-1 and 7-6).

Active groundwater systems in the Colton, Flagstaff-North Horn, and Price River Formations are separated from the Blackhawk Formation by the Castlegate Sandstone. As discussed in Section 724.100, this formation contains no springs and is not considered to be a major groundwater resource. Past mining in the Horse Canyon Mine has not increased the rate of spring discharge from the Price River Formation, indicating that groundwater from the overlying formations is not being diverted into this formation. The absence of increased saturation in the Price River Formation indicates that vertical zones of artificially-increased hydraulic conductivity or secondary porosity does not extend into the Price River Formation and from thence into the overlying active groundwater systems of the North Horn-Flagstaff Formations.

Data presented in Appendices 7-1 and 7-6 and summarized in Section 724.100 indicate that the low-permeability lower groundwater system, in the vicinity of mined coal seams, contains groundwater which is compartmentalized both vertically and horizontally. Coal mining locally dewaters isolated, overlying saturated rock layers in the Blackhawk Formation but does not appear to draw significant additional recharge from overlying or underlying zones.

Additionally, the springs which supply most of the local flow discharge from the upper discontinuous perched aquifers in the Flagstaff-North Horn or Colton Formations. These ~~formations or aquifer are perched from~~springs or groundwater zones receive snowmelt and precipitation recharge from the local area above each spring. The recharge area for each spring is limited, as evidenced by the limited flow rates, decreasing flow through the year, and the steep topography above them. Also they are perched above the underlying lower groundwater zone and the intervening formations contains swelling clays which tend to heal small fractures. ~~Also, s~~Since the perched ~~aquifer~~zones materials are isolated both vertically and horizontally and are lenticular in nature, there is a great~~er~~ probability that fractures in one area will not drain all the different perched aquifers because they are not interconnected. As the strains from subsidence are not expected to reach the level of the upper groundwater zone, there is little chance that the recharge to these springs might be affected.

The very low permeability and vertical gradients in Blackhawk Formation rock layers underlying actively mined coal seams in the Horse Canyon Mine and the absence of significant discharge into the mine from these layers indicates that mining does not draw groundwater from the underling portions of the Blackhawk and Mancos Shale. Additionally, the distinctive solute composition of Mancos Shale groundwater has not been observed inside the Horse Canyon Mine indicating that the saturated zones in the Blackhawk and Mancos are separate.

From the above discussion, it appears that the Horse Canyon Mine has not decreased groundwater discharge in overlying or underlying groundwater systems. ~~Hence~~Since the conditions of the springs in the area of the Lila Canyon Mine are the same, with the same strata, it is unlikely that coal mining will effect the discharges of any spring as a result of mining in the Lila Canyon permit and adjacent areas.

~~As discussed in~~Concern has been raised that the mining might impact flows in the Range Creek basin. This issue has been addressed in the MRP, Section 724.200, ~~as a result~~Pages 29-33. As discussed in the MRP, the distance of the five to six miles horizontal distance from proposed permit area to Range Creek (see Plate 7-1a) and the isolating effects of the over 1,000 feet of low-permeability, isolating strata between the coal seam and the creek elevation (see Plate 7-1B and Table above) and the limited potential ~~and~~ impact of subsidence damage to the recharge area, it is not likely that the Lila Canyon Mine will adversely effect Range Creek. Due to these conditions, no baseline or other sampling has been gathered nor is anticipated on Range Creek. For the above reasons Lila Canyon extension does not present any Probable Hydrologic Consequences to Range Creek.

The contamination, diminution, or interruption of any water resources would not likely occur within the mine permit or adjacent areas. Since surface water flows only a limited part of year and will be provided protection by use of sediment controls, the major usable water resources that could potentially be effected in the area would be springs that are currently in use by wildlife and livestock. Most of these springs are located upstream of the permit area or are in areas where subsidence resulting from post-1977 mining is not documented or expected. To date no known depletion of flow and quality of surveyed springs in the Horse Canyon permit area exists, and none are expected in the Lila Canyon area, based on available data from the Horse Canyon Mine. Although pre-mining data is not available for Horse Canyon, depletion problems from subsidence are not known to have been filed and are not indicated by sampling results in Appendices 7-1 and 7-2. Therefore, it is unlikely an alternative water supply will be needed, although they have been identified in Section R645-301-727.

L-16-G and L-17-G are seeps being monitored in Stinky Spring Canyon. Bighorn sheep have been observed within the canyon but have never been observed drinking the water.

Flows from these springs are historically less than 0.5 gpm and show a general seasonal decrease throughout the season. These sites were not identified during baseline surveys and are believed to exist intermittently and are not always evident. The low flow rates and intermittent nature of these springs suggest that they are local in nature.

These springs are located within the Central Graben, which is a block that has been downdropped between 145 and 250 feet relative to the adjacent bedrock. They occur near the contact between the Mancos Shale and the overlying Blackhawk Formation. The fractured nature of the bedrock along the edges of the Central Graben, as a result of the faulting, likely are the limits of the areal extent of the recharge or source area to the springs. The low-permeability of the surrounding Mancos Shale likely isolate the graben block from groundwater in the surrounding bedrock. Thus, the recharge to the springs is likely limited to the area of the consolidated graben block.

As indicated previously, there is no evidence that mining in the Horse Canyon Mine had any influence on the underlying formations. Therefore it is likely that the Lila Canyon Mine would have similar affects. Due to the springs location and lateral separation from the mine, outside the permit area, outside the limit of subsidence, being separated from the mine block by faulting within the Central Graben, and being 500 to 600 feet below the coal seam, there is no potential for Lila Canyon Mine to negatively impact ~~this~~these springs or there recharge sources.

Based on the review of the information presented in section 724.100 of the MRP, there does not appear to be any regional groundwater zone. The upper groundwater zone is a series of discontinuous, lenticular, isolated perched zones with limited recharge. Generally each zone is isolated, both horizontally and vertically, from those surrounding it. This upper zone is separated vertically from the lower zone in the Sunnyside Sandstone by the Castlegate Sandstone. No impacts to the function and quality of the springs in the upper zone are anticipated from mining subsidence.

The underlying groundwater zone is not used for any purpose and has limited ability to produce water due to the low hydraulic conductivity and the depth to water from the top of the Book Cliffs. While this lower zone contains water, it does not meet the definition of an aquifer as indicated above (see discussion in Section 724.100 of MRP).

Potential for Increased Stream Flows

If sufficient water is encountered in the Lila Canyon Mine workings to require discharge of that water to the surface, the flow of the Right fork of Lila Canyon will be increased. This flow ~~would~~could be ultimately to the Price and Green Rivers. The impact of such discharge by the development of the Lila ~~c~~Canyon extension would be quite limited.

The majority of water discharged from the mine would be water held in storage in the saturated zones above the coal seam. It is unlikely that any water below the coal seam would be affected or drained by the mine workings.

It is difficult to estimate the maximum potential discharge from the mine, however, DOGM has determined that a maximum discharge rate of 500 gpm should be used for design purposes. ~~B~~Appendix 7-9 estimates that this discharge would extend a maximum of 3.4 miles downstream of the mine. Under the absolute worst case conditions, if this discharge were to extend to reach the Price River, based on this discharge rate, during the life of the operation, the water extracted would be 22,600 ac-ft of water~~. This would be~~ or approximately 800 ac-ft per year. Discharge for the Price River at Woodside has a mean annual flow of 88,000 ac-ft/yr. Discharge for the Green River at Green River has a mean annual flow of 4,484,000 ac-ft/yr. Therefore the average discharge at 500 gpm from the mine would be 0.9% of the Price River flow volume and 0.02% of the Green River flow volume. Given the standard fluctuations in the stream flows, this small flow addition would have little effect on the streams.

It should be emphasized that the 500 gpm estimate is considered to be conservatively high. The adjacent Horse Canyon Mine had a maximum discharge of 90 gpm. While the Soldier Canyon Mine farther to the north in the Book Cliffs, the rate of water discharged was estimated to be 15,000,000 gallons per year (approximately 30 gpm).

If water does need to be discharged, it will be sampled and discharged in accordance with the approved UPDES Discharge Permit. If the quality parameters of the mine water do not meet UPDES standards, the water will be treated prior to discharge. Treatment may include holding/settling in the mine, pumping to retaining or sediment ponds, chemical treatment or other approved means to prevent non-compliant discharge.

Based on the results of the evaluation presented in Appendix 7-9, the discharge of this amount of water from the mine is not expected to have a significant impact on the downstream resources. Based on the results from Appendix 7-9, the mine discharge flow will be lost due to transmission losses and percolation within 3.4 miles from the discharge point. Therefore, the discharge will not reach the Price, Green, or Colorado Rivers. The discharge of the water will have a positive impact on the vegetation and wildlife of the area by providing a fairly constant supply of water along this limited reach of the channel.

Based on comparison of upstream and downstream data gathered on Horse Canyon Creek which incorporates the analysis from past mine discharges to the channel, water quality will not be drastically affected in the intermittent drainage in the event of discharge of mine water into the channel. The expected impacts to the channels of the Lila Canyon area are very likely to be similar to those at

Horse Canyon due to the close proximity, and similarities of mining and drainage conditions.

Concerns have been raised regarding the character of the streams in the area. Utah still uses the Office of Surface Mining two part definition of intermittent streams -

> "means (a) a stream, or reach of a stream, that drains a watershed of at least one square mile, or (b) a stream, or reach of a stream, that is below the local water table for at least some part of the year and obtains its flow from both surface runoff and groundwater discharge." Utah Admin Code R645-100 (2006)

The first part is an arbitrary size determination, while the second part is a scientific definition. While the drainage areas of several of the streams within the proposed permit area are greater than one square mile, the character of the flows in all the channels are ephemeral in nature. Colorado, Montana, New Mexico, and Wyoming regulatory programs have changed their rules to use the scientific definition for an intermittent stream and do not use an arbitrary size to determine the flow condition of a stream.

Appendix 7-6 presents the characteristics of the channels within the proposed permit area. The characterization is based on the definition of ephemeral streams in the DOGM rules. Reaches of these streams flow only in response to direct precipitation and based on monthly monitoring at no point in the year does the groundwater table extend above the bottom of the channel to provide baseflow to the channel. Therefore, the channels fit the criteria for ephemeral drainages. While DOGM rules for drainages greater than one square mile stipulate that these drainages are to be considered intermittent in nature, that does not change the flow characteristics of the drainages.

The intermittent stream definition creates a problem of expectation. An intermittent stream is expected to have flow for a period of the year when the water table is above the ground surface. As such a standard monthly surface water monitoring program should and would be able to sample the flows. An ephemeral stream which does not flow as a general rule, but only in direct response to precipitation events or significant snowmelt, would be expected to be dry. Therefore, a standard monthly monitoring program would not result in flow data except on a very infrequent basis.

As a result, concerns regarding the lack of flow data have been raised for the intermittent streams within the permit area. For these are intermittent streams, it has become an issue as to why no flow and water quality data has been collected. As indicated above, these streams may be defined as intermittent, but they function as ephemeral drainages. For ephemeral streams, the standard condition for the channel is dry. The monthly monitoring has provided data which document the lack of flow. The flow modeling, described in the MRP section 724.200 for the watersheds within the permit area, suggests that for short duration, frequent storms (2 to 10 yr), while the watershed would be wetted, no generally concentrated flow would be evident. Higher frequency, longer duration events (10yr +) would result in increasing amounts of runoff. Therefore, for a short period (less than 10 years), the expected flow condition for an ephemeral character stream would be no flow.

Based on the data from the Western Regional Climate Center, presented in MRP section 724.400, the probability of precipitation events capable of generating runoff is very low. Table 7-1C shows that the probability of a 1-day event with more than 0.5" of runoff is less than 5 percent. According to the flow simulations in section 724.200, runoff is not common in storms with less than 1.2 inches of rainfall (10 year event).

Also, the lack of monthly water monitoring data for the period of December and January for most years was raised as a concern. Generally, the access to the sites is prevented by snow. This is not considered a significant problem due to the general lack of precipitation and flow during this period. Average precipitation at Sunnyside during December and January is generally under 2 inches of precipitation of the annual average of over 14 inches (see Table 7-1B). Average maximum temperatures during December and January at Sunnyside are reported to be around freezing (see Table 7-1B). At the mine site, the elevation is higher, therefore, the temperatures would be lower. Thus, any precipitation would generally be in the form of snow which would not result in a runoff event. Any snow melt which might occur would be at a very slow rate which would also not result in runoff, but would likely ripen the snowpack and locally infiltrate into the soil.

Further, a concern regarding the identification of seasonal variation in flows and water quality has been raised. Based on the monthly monitoring, there has been no consistent or seasonal flows identified in any of the drainages in the proposed permit area. Thus, the modeling presented in the MRP section 724.200 is representative of the flows in the drainages. These are characterized by infrequent runoff events from isolated, heavy precipitation occurrences with very limited durations. Based on these types of runoff events, the drainages are ephemeral in nature and the use of the downstream waters is very limited. This is evidenced by the lack of State appropriated waters in the downstream drainages. There are no water rights with acknowledged flows found on the downstream drainages. Only one partially functioning BLM stock pond is found within the Grassy Wash drainage. Based on a site visit in January 2004, the pond is silted in, though a new diversion works had been constructed. In checking with the BLM personnel, the pond improvements were not part of agency range improvements. Recent site visits have shown that the diversion structure in the Right Fork of Lila Canyon has been breached. This will result in very limited flow reaching the pond. Given the limited flow and lack of use, there is little impact that could be achieved by the mining activities.

Potential Hydrocarbon Contamination. Diesel fuel, oils, greases, and other hydrocarbon products will be stored and used at the site for a variety of purposes. Diesel and oil stored in above-ground tanks at the mine surface facilities may spill onto the ground during filling of the storage tank, leakage of the storage tank, or filling of vehicle tanks. Similarly, greases and other oils may be spilled during use in surface and underground operations.

The probable future extent of the contamination caused by diesel and oil spillage is expected to be small for three reasons. First, because the tanks will be located above ground, leakage from the tanks will be readily detected and repaired. Second, spillage during filling of the storage or vehicle tanks will be minimized to avoid loss of an economically valuable product. Finally, the Spill Prevention Control and Countermeasure Plan which will be developed for the site will provide inspection, training, and operation measures to minimize the extent of contamination resulting from the use of hydrocarbons at the site. This plan is not required to be submitted. However, a copy will be maintained at the mine site as required by the Utah Division of Water Quality.

Road Salting. No salting of roads will occur within the permit area. Hence, this impact is not a significant concern.

Coal Haulage. Coal will be hauled over the county road from the mine portal area to Utah Highway 6 and thence to its ultimate destination. In the event of an accident which causes coal to spill from the trucks, residual coal following cleanup of the spill may wash into local streams during a runoff event. Possible impacts to the surface water are increased total suspended solids concentrations and turbidity from the fine coal particulates. The probability of a spill occurring in an area sufficiently close to a stream channel to introduce coal to the stream bed is considered small.

In addition to spills, wind may carry coal dust or small pieces of coal from the open top of the coal trucks into drainages near the roads. The impact from are not expected to experience any significant deformation for covers over ~~450~~630 feet. In the adjacent Horse Canyon mine, which was mined for over 45 years, there have been no reported effects on springs due to subsidence.

Alluvial Aquifer Abstractions into Mines - There will be no water infiltrations from alluvial systems into the mine.

Postmining Inflow to Workings - Postmining all openings will be sealed and backfilled. The proposed mine openings for Lila Canyon are at an elevation where no surface inflow is possible. This coupled with the sealing plan for the portals makes postmining inflows virtually impossible.

Coal Moisture Loss - It has been estimated that coal moisture loss or usage to be estimated at 4.5 gallons per ton of coal mined (see Table 2). Using the estimated usage for mining with an estimated production of 4.5 Million tons per year a usage of 20,250,000 gal per year or 62.12 acre feet can be estimated. It should be noted that due to the extremely low hydraulic conductivity rates measured in the general area, that groundwater movement is very slow. Using the average hydraulic conductivity measured for Blackhawk Sandstone (3.0×10^{-6} cm/sec) (see Table 1) which is equal to .1 inch per day. Therefore, water encountered underground would take approximately 1,736 years to travel one mile. This water is considered relatively immobile. The water encountered and used underground would not reach the Colorado Drainage in any reasonable time, if ever, and thus water consumed underground cannot negatively effect the Colorado River Basin.

Surface Dust Suppression It has been estimated that usage on the surface for dust suppression will be approximately 10,000 gallon per day or 3,650,000 gallons per year. This results in a usage of 11.20 acre feet per year.

Direct Diversions - no consumption.

Adding the four losses due to mining equals to 80.81 acre feet which is below the mitigation level of 100 acre feet. UEI does hold 362.76 acre feet of underground water rights to offset any consumption. Therefore, it is the opinion of UtahAmerican Energy, Inc. that water consumption by underground coal mining operation will NOT jeopardize the existence of or adversely modify the critical habitat of the Colorado River endangered fish species.

Conclusion

APPENDIX 7-8

Water Monitoring Location Descriptions

Last updated November 2006

Changed Pages

L-9-G
Pine Spring

Location: L-9-G is located in an unnamed side canyon approximately 1.25 miles from Little Park Wash. Located in the Flagstaff/ North Horn Formation at an elevation of 7200 feet. Stream reach is intermittent by definition but is ephemeral acting (See Appendix 7-7 & Plate 7-4). Flow from the spring flows approximately 400 feet down stream where it evaporates or is absorbed. The drainage above and below this spring flows only as a result of spring run-off or storm events.

General: The coal seam at this location lies approximately 2,300 feet below the spring. The spring is located along the channel and just inside of the permit area. Due to its location, thickness of the overburden, and the tendency for the overlying formations to swell and seal, there is no potential for Lila Canyon Mine to negatively impact this spring or recharge sources. The permittee has never observed amphibians at or near this location.

Vegetation description: A wet meadow habitat is present within the area of the monitoring site. An overstory of Pinyon-Juniper and sagebrush grass lies immediately adjacent along each side of this site. The wet meadow habitat was washed out or covered with sand and gravel as a result of storm events in Aug 2003. Indications of localized riparian habitat exists. Moss, sedge, willow, columbine observed.

L-19-S
Little Park Wash

Location:

L-19-S is located in Little Park Wash at the permit boundary. The flow at this site is nearly the same as for L-13-S. There are no contributing sources between the two sites other than overland flow. Essentially, the data already recorded for site L-13-S is representative of the new site. Located in Alluvium adjacent to the Upper Price River Formation at an elevation of 6725 feet. Stream reach is intermittent by definition but is ephemeral acting (See Appendix 7-7 & Plate 7-4). The drainage above and below this monitoring location flows only as a result of spring run-off or storm events.

General: The coal seam at this location lies approximately 1400 feet below the monitoring location. Due to its location outside of the subsidence area, depth of the coal, and the tendency for the overlying formations to swell and seal, there is no potential for Lila Canyon Mine to negatively impact this monitoring location. The permittee has never observed amphibians at or near this location.

Vegetation description: The area surrounding the dry wash monitoring site consists primarily of mature sagebrush habitat.

APPENDIX 7-9

Right Fork of Lila Canyon Flow and Geomorphic Evaluation

Hydrologic Design

Thomas J. Suchoski

Redline

INTRODUCTION:

On January 31, 2004 a stream evaluation was conducted of the Right Fork of Lila Canyon downstream of the proposed mine facilities toward the Price River. The purpose of the study was to determine the impact of a continuous discharge of 500 gpm from the mine would have on the downstream channel. A series of cross-section measurements were taken to characterize the channel configuration and the channel bed and bank materials. Photographs were taken of each cros-section location looking upstream and downstream to help visualize the conditions at the cross-section. Also, a photograph of the bed and bank materials was taken to aid in classifying the material type. The photographs are presented in Attachment #1 to this Appendix.

Figure 1 shows the location of the cross-section sites. The original plan was to collect cross-sections at one-half mile spacings along the channel alignment between the mine site and the Price River. However, at the third cross-section location, a recent diversion structure was found which diverted the normal flow of the Right Fork of Lila Canyon. Previously the flow from the Right Fork joined with the flows from Grassy Wash. However, with the diversion, the entire flow of the Right Fork is diverted to a diversion channel. The location of the diversion dam and alignment of the diversion channel is presented in Figure 1. Ultimately, the diversion channel will convey the flow to a stock pond located in the SW/4, SW/4 of Section 28, T. 16 S., R. 14 E.

This stock pond is a BLM pond. The ~~agency had implemented~~work appeared to be part of implementation of a range improvement program in the area of the pond. As part of this program, the embankment had been improved and raised, the outlet riprapped, and the diversion structure moved upstream and improved to collect additional flows. However, the pond area was filled with silt or sediment.

The result of this range improvement project is that the flows from the Right Fork of Lila Canyon will be diverted to the stock pond. If the pond fills, any excess water will be released back to Grassy Wash. Based on the size of the pond, if cleaned, it appears that the pond will hold about 5 to 7 acre-feet.

Results:

Channel sections

The Right Fork of Lila Canyon is an ephemeral channel which is incised into the pediment surface below the Book Cliffs. At cross-section location 1, the

APPENDIX 7-10

Peak Flow Simulation Results

UtahAmerican Energy, Inc.

R. Jay Marshall P.E.

Red Line

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INTRODUCTION:

The following simulation was prepared to provide a characterization of the variation of flow as a result of differing rainfall return periods within each drainage basin within the Lila Canyon Permit Area. Surface waters in or adjacent to the permit area have not exhibited flow on a long term basis and therefore were characterized as intermittent or ephemeral in nature.

General:

Figure 1 for Appendix 7-10 presents the nine drainage basins that were evaluated as part of the simulations. These drainages include: Noname Wash (WS1), ~~Pine Spring Wash (WS2),~~ Little Park Wash (WS ~~3~~2 through 6), Stinky Spring Wash (WS 7), Lila Canyon (WS 9), and a smaller tributary (WS 8).

The drainages were simulated for the 6-hour and 24-hour rainfall events. This provides an assessment of the drainages response to different types of rainfall events. The 6-hour events are typical of local, isolated high intensity thunderstorms, while the 24-hour events are typical of large, frontal type storms. Rainfall data were obtained from the precipitation frequency data server from the NOAA web site (see Attachment 1)

The simulation was conducted using the Hydroflow program prepared by Intelisolve. This program uses the NRCS unit hydrograph method with selected rainfall distributions to simulate peak flows. It also incorporates channel routing and hydrograph addition to allow multiple watersheds to be simulated and modeled to determine the effect on combined watershed flows.

For the simulation, the watersheds were modeled using a weighted curve number value to cover the entire watershed. This value was determined based on professional judgement using soils and vegetation information from the watershed areas. For the watersheds, the curve number was based on a hydrologic soil group of 'B' due to the sandy soils predominant in the higher elevations and a combination of sage-grass and juniper-grass vegetation with a ground and canopy cover percentage of 40 (see Figure 9.6 from NEH-4 Attached). Hydraulic length and slope values were determined from the topographic maps of the area. Watershed inputs are presented in Table 1.

Channel routing parameters were determined from field observation and from topographic maps of the area. Channel routing inputs are presented in Table 2.

Simulations were prepared for the 2-, 5-, 10-, 25-, 50-, and 100-year, 6-hour and 24-hour rainfall events for each watershed.— The results of these simulations are presented in Table 3. These simulation results present the individual watershed values for watersheds 1, 7, 8, and 9 and the cumulative flows at the junction points within the channel or the total flow for the watershed Little Park Wash. Graphs of the combined hydrographs of each watershed are presented in Attachment 2.

The difference in peak flow from these simulations versus the peak flow calculated in Appendix 7-9 for similar watersheds is the difference in methods. One uses the rainfall runoff relationship of the NRCS and one uses the channel geometry basin size regression analysis. Both methods have application in determining peak flow from a watershed. The regression analysis assumes that all watersheds in the area of a given size and elevation meets the same flow conditions of all other watersheds in the area. This is not always the case. In any regression analysis there is fluctuation in the prediction.

In the case of the rainfall runoff relationship, the prediction is based on the an understanding of the rainfall depth and intensity of the precipitation event and the characteristics of the watershed land condition. The NRCS simulation requires more data regarding the specific watershed being studied than the regression analysis and, so long as the inputs are reasonable and representative of the watershed, is generally deemed a more accurate predictor.

Table 1 PEAK FLOW SIMULATION WATERSHED INPUTS					
Watershed ID	Drainage Area (ac)	Curve Number	Hydraulic Length (ft)	Basin Slope (%)	Time of Concentration (min)
WS1.1	427	65	7290	21.8	50.88
WS1.2	566	65	7520	4.3	118.03
~~135.004.78560 65317WS2.257 .8022.0781065 272WS2.1~~WS7.1	849	65	12880	19.7	84.30
WS8.1	278	65	9670	21.1	64.80
WS9.1	1317	65	13900	20.0	89.00
Little Park 6.1	499	65	7930	20.8	55.70
Little Park 6.2	285	65	6790	19.3	51.10
Little Park 6.3	94	65	2170	4.2	44.20
Little Park 5.1	77	65	2230	44.8	13.70
Little Park 5.2	213	65	4550	13.2	44.80
Little Park 4.1	189	65	3850	31.3	25.40
Little Park 4.2	232	65	5010	10.4	54.60
Little Park 6.4	67	65	2370	4.2	47.00
Little Park 6.5	276	65	6770	17.5	53.50
Little Park 6.6	383	65	5730	3.3	107.50
Little Park 3.1	687	65	7090	24.2	47.20
Little Park 3.2	379	65	4980	4.4	83.30
Little Park 6.7	~~760~~399	65	~~10770~~5760	2.9	191.30
Little Park 2.1	272	65	7810	22.0	57.80

Table 1

PEAK FLOW SIMULATION WATERSHED INPUTS

Watershed ID	Drainage Area (ac)	Curve Number	Hydraulic Length (ft)	Basin Slope (%)	Time of Concentration (min)
Little Park 2.2	333	65	7010	4.7	106.20
Little Park 6.8	444	65	6810	2.9	132.1

Table 2

PEAK FLOW SIMULATION CHANNEL INPUTS

Channel ID	Reach Length (ft)	Mannings n	Side Slope (xH:1V)	Bottom Width (ft)	Channel Slope (%)
WS1 Channel	7520	0.030	2	8	4.3
WS2 Channel	8560	0.030	2	8	4.7
WS6.3 Channel	2170	0.030	2	8	4.2
WS5.2 Channel	4550	0.030	2	8	13.2
WS6.4 Channel	2370	0.030	2	8	4.2
WS4.2 Channel	5010	0.030	2	8	10.4
WS6.6 Channel	5730	0.030	2	8	3.3
WS3.2 Channel	4980	0.030	2	8	4.4
WS6.7 Channel	~~10770~~5760	0.030	2	8	2.9
WS6.8 Channel	6810	0.030	2	8	2.9

Table 3

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES
IN THE LILA CANYON MINE AREA

Watershed ID	Return Period	2yr (cfs)	5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
~~WS2.1~~WS7 Total	~~WS7.13 6.8321.5 612.414. 621.670. 3224 hr16.278 .202.980 006 hr WS2 Total17. 3410.70 6.472.52 0.910.18 24 hr8.554. 141.430 006 hr WS2.22 4.9014.2 37.962.5 40.810.1 724 hr7.794. 301.840 006 hr~~6 hr	0	0	2.23	10.43	19.63	33.75
	24 hr	1.29	6.04	15.85	36.15	60.94	90.24
~~WS8.1~~WS8 Total	6 hr	0	0	0.85	3.60	6.59	11.34
	24 hr	0.43	2.09	5.76	13.64	23.46	35.09
~~WS9.1~~WS9 Total	6 hr	0	0	3.46	16.17	30.46	52.36
	24 hr	2.01	9.38	24.59	56.08	94.53	139.99

Table 3

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES
IN THE LILA CANYON MINE AREA

Watershed ID	Return Period	2yr (cfs)	5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
Little Park 6.1	6 hr	0	0	1.63	6.48	11.66	20.08
	24 hr	0.76	3.76	10.88	26.5	46.16	69.84
Little Park 6.2	6 hr	0	0	0.93	3.70	6.66	11.47
	24 hr	0.44	2.15	6.21	15.14	26.36	39.89
Little Park 6 Cumulative	6 hr	0	0	2.56	10.18	18.33	31.54
	24 hr	1.20	5.91	17.09	41.63	72.52	109.74
Little Park 6.3	6 hr	0	0	0.32	1.21	2.15	3.70
	24 hr	0.14	0.70	2.17	5.47	9.75	14.92
Little Park 5.1	6 hr	0	0	0.31	1.00	1.73	2.93
	24 hr	0.11	0.59	2.41	7.85	15.16	23.59
Little Park 5.2	6 hr	0	0	0.73	2.75	4.87	8.38
	24 hr	0.32	1.59	4.92	12.40	22.10	33.82
Little Park 5 Cumulative	6 hr	0	0	2.82	11.34	20.41	35.22
	24 hr	1.77	8.54	24.80	61.16	107.32	163.42
Little Park 4.1	6 hr	0	0	0.75	2.58	4.47	7.65
	24 hr	0.29	1.49	5.31	14.72	28.04	43.72
Little Park 4.2	6 hr	0	0	0.76	3.01	5.42	9.33
	24 hr	0.36	1.75	5.06	12.32	21.46	32.47

Table 3

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES
IN THE LILA CANYON MINE AREA

Watershed ID	Return Period	2yr (cfs)	5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
Little Park 6.4	6 hr	0	0	0.23	0.86	1.53	2.64
	24 hr	0.10	0.50	1.55	3.90	6.95	10.64
Little Park 6.5	6 hr	0	0	0.90	3.58	6.45	11.10
	24 hr	0.42	2.08	6.02	14.66	25.53	38.63
Little Park 4 Cumulative	6 hr	0	0	6.17	24.81	44.74	77.12
	24 hr	2.93	14.01	40.73	101.08	178.91	269.04
Little Park 6.6	6 hr	0	0	0.87	4.44	8.64	14.92
	24 hr	0.58	2.60	6.58	14.58	24.18	35.52
Little Park 3.1	6 hr	0	0	2.35	8.86	15.72	27.03
	24 hr	1.03	5.13	15.87	40.00	71.27	109.07
Little Park 3.2	6 hr	0	0	1.00	4.65	8.76	15.07
	24 hr	0.58	2.70	7.08	16.14	27.20	40.29
Little Park 3 Cumulative	6 hr	0	0	9.73	42.29	77.65	133.01
	24 hr	5.08	23.46	65.66	162.22	284.24	430.10
Little Park 6.7	6 hr	0	0	~~1.12~~0.76	~~6.47~~4.53	~~14.50~~9.00	~~26.85~~15.63
	24 hr	~~1.14~~0.60	~~4.69~~2.69	~~10.58~~6.66	~~21.76~~14.57	~~49.42~~23.96	~~Little Park~~35.04
Little Park 2.1	6 hr	0	0	0	1.84	4.30	7.79
	24 hr	0.17	0.81	2.54	7.96	14.23	24.90
Little Park 2.2	6 hr	0	0	0.64	3.68	7.15	12.35
	24 hr	0.48	2.16	5.45	12.07	20.02	29.40

Table 3

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES
IN THE LILA CANYON MINE AREA

Watershed ID	Return Period	2yr (cfs)	5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
Little Park 2 Cumulative	6 hr	~~6 hr~~0	~~10.48~~0	~~47.97~~11.07	~~90.92~~54.40	~~152.74~~100.57	168.92
	24 hr	6.59	29.31	80.68	192.12	329.11	493.91
Little Park Total	6 hr	0	0	11.56	58.64	110.02	183.99
	24 hr	~~6.19~~7.24	~~26.34~~31.45	~~70.46~~84.30	~~170.78~~199.12	~~298.11~~340.37	~~448.73~~508.74